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# DDC 10 YEAR REQUIREMENTS AND PLANNING STUDY

## Expert Panel Review Report

AUERBACH ASSOCIATES INC.
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Progress Report



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An evaluation by expert panels was performed as a phase of an overall study to develop technical objectives for DDC planning in the 1978-1988 time period. The approach taken was a modified composite of two approaches: (a) The SEER (System for Event Evaluation and Review) approach used by the Naval Supply Systems Command, and (b) the Probe II methodology of the TRW Corporation. This composite methodology consists of four steps: (a) development of an events list derived from a literature survey and an

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interagency survey, (b) evaluation of the events list by experts involved in information transfer at the systems level, (c) modification of the events list based on the first evaluation, and reevaluation of the list by a second panel of experts in information technology at the agency level concerned with long range planning and development, and (d) analysis of results, definition of the state of the art and probable time phasing of the events evaluated as desirable and feasible.

Illustrations are presented summarizing the concensus of the evaluation and probable timing by importance of the event, and goals for accomplishment.

TECHNICAL NOTE
AUER-2325/2326-TN-5

# EXPERT PANEL REVIEW REPORT

December 31, 1975

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Submitted to;

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# SECTION I. INTRODUCTION

The Expert Panel Review Report is an interim document. It presents the results of one major task in AUERBACH's long range planning study for the Defense Documentation Center under Contract No. DSA900-75-C-5161. The conclusions and recommendations discussed in this volume are directed toward predicting the likely course of advancement of information processing technology.

## 1.1 PURPOSE AND USE OF THE TECHNICAL NOTE

This document is intended to be used primarily by DDC and the project team to formulate a set of reasonable time-phased assumptions about future information technology, information organizations, and economic factors. As a project document, the Expert Panel Review Report serves as an outline of future developments, which will influence the final recommendations of the comprehensive study now underway for the target period 1978-1988. For this review, the results of a literature survey, an interagency survey and an internal review of DDC plans and operations have been converted to a select list of future events that are expected to be especially relevant to the DoD RDT&E information processing and using community. However, some of the conclusions have a generality about them that could have implications beyond DoD. Thus, agencies other than DoD agencies may find these results of interest.



## 1.2 EXPERT PANEL REVIEW SUMMARY

Highlights of the Expert Panel Review and AUERBACH's conclusions and interpretation are:

- Important Trends
  - Scientific bibliographic information systems are following a trend that will eventually result in a comprehensive, international, cross disciplinary and integrated data resource that will be accessible to individuals through single access points
  - The highest payoff area for increased scientific and technical information service is factual data services that are non-bibliographic
  - Information analysis services will be an increasingly important component of total technical information systems
  - The application of electronic devices to the control and manipulation of information data is a dominant trend. The particular devices themselves are basically of incidental importance. It is the applications techniques for information handling that facilitate total electronic control of technical information processes that are among the most important matters to be resolved.

- Technology
  - Large computers designed specifically for textural information processing are unlikely. Peripheral and decentralized special purpose units are desirable and feasible
  - Complete electronic control over information processing operations is desirable. A number of approaches are feasible depending on various system requirements
  - Electronic storage and dissemination media will virtually supplant microform media

- Organizational Structures and Affiliations
  - Interorganizational cooperation and standardization is fundamental to the advancement of information processing technology



- Economics
  - Cost alone is not a barrier to the advancement of information processing technology
- Services
  - New concepts in service are seen as highly desirable and feasible but a perplexing pessimism is expressed concerning the ability of the information community to develop them
  - Widespread accessibility to many data bases is a highly desirable objective
  - Fact services are a conspicuous gap in current information services
- Time-Phased Goals
  - Quantum advancement of information processing technology is not seen before 1985. Interim progress may be characterized by standardization and expanded bibliographic information services involving multiple data base access and interactive search capability

## 1.3 METHODOLOGY

The method used by AUERBACH to conduct the Expert Panel Review is a modified composite of two Delphi-like approaches: (a) the SEER (System for Event Evaluation and Review) approach developed and employed for technology assessment by Bernstein, et al[1] of the Naval Supply Systems Command, and (b) the Probe II methodology of the TRW Corporation employed by North and Pyke.[2] AUERBACH's composite methodology consists basically of four steps:

(a) Development of a compendium of factual data and potential events, and distillation of this data into an original Events List. (Discussed in Section 1.3.1 below).

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[1] Bernstein, G. B. et al. A Fifteen-Year Forecast of Information Processing Technology, Washington, D.C., Naval Supply Systems Command, 1969. (AD 681752).

[2] North, H. Q. and Pyke, D. L. "Probes of the Technological Future." Harvard Business Review, 47(3):68-82, May-June 1969.

(b) (Round I) Evaluation of this original Events List by experts involved in information transfer at the R&D, operations and product planning levels. (Discussed in Section 1.3.2 below).

(c) (Round II) Modification of the Events List based on the results of Round I, and re-evaluation of this new Events List by a second round panel of specialists in information technology and individuals in influential information science positions who are concerned with long range planning and administration (Discussed in Section 1.3.3 below)

(d) Analysis of results, definition of the state-of-the-art and definition of potential alternative short, mid- and long-range goals and identification of events necessary or desirable to support these goals.

### 1.3.1 Development of the Events List

A Literature Survey generated a list of about 70 "raw" events covering technological trends and future predictions for the information community. These "raw" generalized events were then distilled into 41 events, which were seen as the most relevant and specific to DDC's plans and interests. This was done through the following steps:

- Close inspection of all available DDC descriptive and planning documents to isolate areas of high interest for DDC
- Review of the documentation of the Interagency Survey (a related task under the present contract), to point out developments in allied organizations which would be most likely to impact on DDC.
- Formulation of a series of questions in connection with the areas of interest (uncovered as described above) representing planning options for DDC (Shown in Appendix D)
- Translation of the questions into a list of carefully worded events, designed to elicit maxium feedback relevant to the DDC plans.

### 1.3.2 Round I

Round I procedures were as follows:

(a) Selection of Round I Participants

The Round I participants were selected to provide expertise at the operation or system design level, such as practitioners and researchers in various phases or aspects of information science (e.g., program managers of significant information systems and academic researchers). Effort was made to achieve a broad

coverage of many organizations. Of the 10 Round I participants, five represented government agencies, three represented private "for profit" companies, and two represented academic institutions.

(b) Solicitation of Responses

The Round I Events List was mailed to all participants. Approximately five days later, an AUERBACH representative visited each participant to physically collect the List and to answer any questions the participant might have. The visit also acted as a deadline so that the participant could not put off responding to the Events List.

(c) Analysis of Round I Responses

The collected Round I Events Lists were cut apart so that each question was on a separate piece of paper. Then all the "event number 1's" were clipped together, etc. The number of responses for each category and subcategory was tallied, and the percentages calculated. If, for example, 9 participants responded to the USER DESIRABILITY section of a particular event, and of these, 3 checked "desirable" then the percentage of "desirable" responses for that event was 33%. Years given in the PROBABLE TIMING section were averaged for each of the three probabilities of each event. The comments for each event were read carefully and analyzed to uncover event ambiguity, redundancy, and low probability of occurrences. Results and comments were used as a guide to the modification of the events for Round II. (See Section 1.3.3 below).

1.3.3 Round II

Round II was the second iteration of the two part Expert Panel Review. The refined events list of Round I was reviewed as follows:

(a) Modification of the Round I Events List

Based on the responses of the Round I participants, three types of modifications were made in the events: reduction of "abstracts" (changing "all" to "most," for example); narrowing of scope (rewriting one event as two); and the elimination of six events which were seen by a majority of Round I participants as both undesirable and unfeasible.

(b) Division Into Two Events Lists

Round II was to be conducted with two separate sets of participants: a panel of experts in information technology, and a panel of individuals in influential information science positions. This division of Round II was designed to achieve a high level of precision in the Round II responses. Each panel represented a specific segment of expertise and the events were divided to eliminate extraneous opinions from panelists in areas outside their area of expertise. Accordingly, the revised events were

converted to two lists: Round IA, events concerning information technologies, and Round IIB, events concerning information issues. Since a large number of events had implications for both technology and issues, they were included on both lists. The Round IIA and IIB Events Lists with the aggregate data are included as Appendices B and C, respectively.

(c) Selection of Round II Participants

The Round II participants were chosen to represent two areas of expertise - technology (panel A) and planning and administration (panel B). Round II structure was weighted to favor the input from the planners and administrators by selecting 17 members for panel B versus 10 for panel A (In the analysis the aggregate data were averaged, thus the 17 panel B responses tended to have greater influence on the mean).

It was expected that the points of view expressed by the two homogeneous panels would be divergent when examined separately. This assumption proved to be valid. The results were blended to moderate any extreme opinions (especially negative opinions) since the experience with forecasting studies of this type show that technological progress is often realized sooner than the experts predict. Thus, we hope these results will accurately represent the future path of information technology advancement. This part of the methodology was applied only to those events which had implications in technology as well as in organizational, economic and service aspects of information science.

Events that were purely related to technology or purely related to planning and administration issues were submitted only to the respective experts in these areas. This was done to avoid collecting spurious data provided by panelists beyond their area of expertise. (Appendices A, B, and C indicate the events submitted to each panel.)

The ten Round IIA participants (technology experts) were selected from the staff of the AUERBACH Corporation (excluding the DDC study project team). All are senior personnel with special expertise in the fields of computers, micrographics, teleprocessing, or information systems design. Panel IIB consisted of 17 individuals in influential information science positions who are concerned with long range planning and administration. They represent a cross section of the information community. Three were affiliated with government agencies, seven with for-profit organizations, and seven with not-for-profit institutions.



(d) Solicitation of Responses from the Round IIA Participants

The Round IIA Events Lists were distributed in person by a member of the project team to panelists who previously had been asked to participate. The purpose, scope and procedures of the task were reviewed at the outset and each panelist was permitted one week to respond. (The list required about 1½ hours to complete). The events were collected at the end of the week and panelists were debriefed on their experience with Round IIA review instrument.

(e) Solicitation of Responses from the Round IIB Participants

The Round IIB panelists (who had been invited to participate by telephone with follow-up letters of invitation) received their copies of the Events Lists at an initial group meeting. At that meeting, the project was reviewed and the purpose scope and procedures for the review were outlined. There was no group discussion of the events. The review was estimated to be approximately a 1½ hour effort. Completed events lists were to be returned by mail. All results were received within two weeks.

(f) Analysis of Round II Responses

Each panelist's responses were first examined to see if there were inter-event inferences reflected in the responses - especially the comment responses. If so, they were noted on each involved event. Then the events were physically separated and recombined so that all responses to a given event were merged. The aggregate data were collected and the totals were used to calculate the values for each event. Importance was measured as the percentage of panelists who indicated an event as "important." "Desirability" and feasibility ratings (assigned on a scale of 1 to 10) were averaged for each event. The "probable timing" dates (i.e., forecasted dates) were averaged, as well. The data were analyzed within specific areas of interest, generally categorized under four main areas - technology, organizational structures, economics and marketing and services. They were also analyzed for trends reflected in the comments and by implication of the relative scores of interrelated events. Appendix A consists of several tables compiled to aid the analysis with cross comparisons between and among the events. Appendices B and C report the aggregate data from Round IIA and Round IIB respectively.

## 1.4 RELATIONSHIP OF THE EXPERT PANEL REVIEW TO THE STUDY AS A WHOLE

The Expert Panel Review is but one of four major facets of AUERBACH's long range planning study for DDC. The other three consist of: a User Survey,



an Interagency Survey, and an Internal Review of DDC Plans and Operations. The findings of all four facets of the study will be assessed and evaluated separately and together as a final report intended to be a DDC planning document appropriate for the user needs, technological capability and interorganization information structure forecast for the decade 1978 to 1988.

## 1.5 ORGANIZATION OF THE REPORT

The remainder of this report is divided into the following sections:

- Section II: Discussion of Findings
- Section III: Conclusions and Interpretations
- Appendix A: Data Tabulation
- Appendix B: Round IIA Aggregate Data with Comments
- Appendix C: Round IIB Aggregate Data with Comments
- Appendix D: Questions and Issues Related to the Events
- Appendix E: Events Classified by Desirability/Feasibility



## SECTION II. DISCUSSION OF FINDINGS

This section discusses the data of the Expert Panel Review task. It consists of:

- A summary of the Round II results, which is the second iteration of the two part Expert Panel Review task.
- A comparison of the results from panel IIA (Technology experts) and panel IIB (Information system planners and administrators)
- A comparison of Round II results with the Round I panel (information system practitioners and researchers)

For the purposes of this report, the following definitions apply:

A. Panel Composition

1. Round I Panel: 10 individuals with expertise at the systems level, such as practitioners and researchers with expertise in various phases or aspects of information science (e.g., program managers of significant information systems).

2. Round II

a. Panel A: 10 technology experts in the fields of computers, micrographics, teleprocessing and information systems design.

b. Panel B: 17 individuals in influential information science positions who are concerned with long range planning and administration.

B. Events List Data Elements

1. Events: significant future occurrences relevant to the information community

2. Importance: whether or not the panel regarded an event as potentially a major occurrence in the information science field

3. Desirability: a relative assessment of the need for a given event within the information community

4. Feasibility: a relative assessment of the practicality of a given event occuring

5. Probability: a relative assessment of when an event is likely to occur

## 2.1 ROUND II FINDINGS

The Round II findings represent the second iteration of the two-part Expert Panel Review. The data are compiled in detailed tables in Appendices A, B, and C. The main features of the findings are presented in this section.

Section III discusses the time phased implications of the findings, which take into account the combined factors of importance, desirability, feasibility, and probable timing.

Round II data were collected for thirty-eight events representing four areas:

- Technology
- Organizational Structures
- Economics and Marketing
- Services

Each event was considered for importance, desirability, feasibility, and probable timing. The data for each event were averaged to give a composite rating that was used for the overall analysis in comparing events against each other.

### 2.1.1 Importance

Participants were asked to designate events that they believed to be "major events." This was done to impart an order of significance to the various events. Results were tabulated as straight percentages of respondents who designated an event as "major." Events accorded the highest ratings (top 20%) were (in order of scores, high to low):

- Interactive access to full text data bases replacing abstracts and indexes as searching tools
- Researchers have access to data bases of factual verified data
- Acceptable machine generated indexes
- Paper will be replaced as the primary numeric storage medium by digital media
- Paper replaced as numeric dissemination medium by digital media
- Accessibility of many data bases through a single terminal
- Standardized citation formats
- Interactive access to citation data bases replacing abstracts and indexes as searching tools
- Information synthesis and analysis available to all researchers
- Optical character recognition (OCR) able to convert any document to machine readable form
- Machine readable storage media competitive with paper

Events accorded the lowest ratings (lowest 20%) were (in order of scores, high to low):

- Two tiers of information providers will emerge and be clearly definable: "wholesalers" and "retailers"
- Minicomputers coupled with perpherals will generally take over many functions currently performed by large centralized computers
- Major IS&R systems will permit a choice of output format



- Input of information to large IS&R systems (e.g., DDC, NTIS, NASA, etc.) will be decentralized, with standardized abstracting, indexing and data conversion provided at the local source level

- Federal technical information services becoming self-supporting

- Dissemination of full text of documents precluding the need for abstracts as announcement devices

- Automatic monitoring built into retrieval systems

- Paper replaced as document dissemination medium by microform

- Computers designed specifically for bibliographic storage and retrieval

These results indicate a select set of "important" trends and/or technological events:

- Scientific bibliographic information systems are following a trend that will eventually (some undetermined date beyond 1988) result in a comprehensive, international, cross disciplinary and integrated data resource that will be accessible to individuals through single access points

- The highest payoff area for increased scientific and technical information service is factual data services that are non-bibliographic

- Information analysis services will be an increasingly important component of total technical information systems

- The application of electronic devices to the control and manipulation of information and data is a dominant trend. The particular devices themselves are basically of incidental importance. It is the applications techniques for information handling that facilitate total electronic control of technical information processes that are among the most important matters to be resolved.

### 2.1.2 Desirability and Feasibility

Respondents were asked to rate the desirability and feasibility for each event on a scale of 1 to 10. The aggregrate scores of panel A and panel B were averaged for each event. Desirability and feasibility averages were used to group events by class ("most" > 7.5, "moderate" 5-7.5, "least" < 5).



The results have been tabulated in Appendix E which lists eight groups from the "Most Desirable, Most Feasible" events to the "Least Desirable, Least Feasible" events. Each group is subdivided by Technology, Organizational Affiliations, Economics and Services. Some events appear on the tables more than once, as they impact on more than one area.

2.1.3 Probable Timing of Round II Events

Participants were asked to project three dates for each event: a date of 20% probability of occurrence, a date of 50% probability, and a date of 90% probability. As a relative indicator, the 50% probability averages give a fairly consistent picture, and as such they are used here as an index of probable timing. Actual forecast dates are provided in Appendix A.

The events considered likely to occur soonest (by 1985) by the Round II Panel (Technology Experts) were the following (average 50% probability dates in parentheses):

- Two tiers of information providers: "wholesalers" and "retailers" (1980)
- Automatic retrieval systems with built-in monitoring features (1981)
- Standardized citation formats for report literature (1982)
- Standardized abstract formats for report literature (1982)
- Duplication in acquisition among data bases will be eliminated (1983)
- Minicomputers coupled with peripherals will take over many functions (1983)
- Personal interactive terminals will be available for less than $500 (1983)

The events judged to take place in the most remote future (beyond 1995) were:

- Paper will be replaced as document storage medium by full text digital media (1997)
- Access to full text data bases will replace abstracting and indexing as searching tools (1997)



- Standardization will allow data bases to be merged into a single file (2000+)
- Paper will be replaced as document dissemination medium by full text digital media (2000+)

The remaining events were all judged to have a 50% possibility of occurring between the mid 1980's and the 1990's.

Actual estimated dates for events are shown in Appendix A and Appendix B together with the completed results of the "A" Event List and the "B" Event List.

## 2.2 COMPARISON BETWEEN ROUND IIA AND ROUND IIB

Of the 38 events considered in Round II, 20 events (representing 26 possibilities) were submitted to both the "A" panel (information technology experts) and the "B" panel (planners and administrators).[1] Seven events appear only on the "A" list and eleven appeared only on the "B" list. Appendix A indicates the events submitted to each group.

### 2.2.1 Importance

The Round IIB panel (administrators and planners) tended to ascribe "importance" to more events than the Round IIA panel (technologists). Specifically, of the 26 events, analyzed for both lists, 16 rated higher in importance in Round IIB than in Round IIA, eight rated higher in Round IIA and two were rated equal in importance in both groups.

These data are not surprising. It was anticipated that the "importance" of the events would be assessed in terms of the benefits that would be inferred from their coming to be. Of the two panels in Round II, the planners and administrators of large information systems (the Round IIB panel) are apt to be more comfortable with anticipating the potential benefits of new technological developments. Therefore, they saw more events as "important."

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[1] Two of the events common to both lists had four parts each. For purposes of analysis, the parts were treated as separate events, bringing the number of common events to 26.

The technology itself appears to lack importance in the judgement of the Round II panels without the inference of useful applications.

Despite the fact that the importance ratings of the B panel were higher than the A panel, both groups ascribed a fairly consistent ordinal ranking to the events, which produced the composite results discussed in Section 2.1.1.

Events on which the importance assessments of the two panels contrasted strikingly were few.

Only one event was highlighted by the Round IIA panel alone:

- Paper replaced as a document dissemination medium by microform

Events highlighted by the Round IIB panel alone included:

- Machine readable storage media competitive with paper
- Machine readable files transferred electronically, competitive with postal service
- Majority of remote retrieval done via dial-up lines
- Facsimile transmission competitive with postal service in cost

### 2.2.2 Desirability

Opinions varied widely among all participants of both groups as to the desirability of individual events. However, a similar pattern was exhibited as that seen for the "importance" designation. Of 26 events analyzed, 15 rated higher in desirability in Round IIB than in Round IIA, seven rated higher in desirability in Round IIA than in Round IIB, and four were judged about equal.

The events considered more desirable in panel A than by panel B were:

- Paper replaced as numeric dissemination medium by microform
- Paper replaced as document dissemination medium by microform

- Use of commercially available software replacing all original software development

The events seen as considerably more desirable by panel B than by panel A were:

- Numeric data processing will equal bibliographic data processing
- Many data bases accessible through a single on-line terminal
- Automatic retrieval systems with built-in monitoring features
- Personal interactive terminals as common as automatic typewriters

### 2.2.3 Feasibility

In feasibility, panel B again tended to rank events higher than panel B. Of the twenty six events, thirteen were rated higher in feasibility by panel B than the panel A, eight were rated higher in feasibility in the panel A than panel B, and five were rated about equal in feasibility by both groups.

Events seen as considerably more feasible by Group A than by Group B were:

- Machine readable storage media for text competitive with microfilm
- Machine generated index data virtually eliminating manual indexing
- Commercially available software virtually replacing original software development
- Standardized user protocols adopted by all technical information services
- Conversational and tutorial on-line capabilities will make intermediaries unnecessary

Events seen as considerably more feasible by panel B than panel A were:

- Machine readable records electronically transferred between locations at low cost
- Personal interactive terminals common
- Paper virtually replaced as document dissemination medium by microform

- Information systems allowing user to specify output format
- Researchers having access to data bases of validated numeric data

### 2.2.4 Probable Timing

The Round IIA panel and the Round IIB panel were relatively consistent in their forecasts of timing. The average forecast ranges of each panel, for each event, tended to overlap with the average data points for 20% probability, 50% probability and 90% probability falling within 5 years of each other. The Round IIB panel (planners and administrators) tended to be somewhat more optimistic than the Round IIA panel (technology experts). Ten of the 26 comparable events were forecast to occur sooner by panel B. Only four events were forecast to have a more proximate probability of occurance by panel A than by panel B. Twelve were forecast approximately even by both groups.

Notable differences (more than 10 years) in the 50% probability forecasts of the two panels are these:

- Events judged to be more proximate by panel A were:
  - Machine readable storage competitive with paper (panel A - 1985; panel B - 1996)
  - Standardization allowing data bases to be merged into a single file by user organizations (panel A - 1993; panel B - 2080)
- Events judged to be more proximate by panel B were:
  - Personal interactive terminals common (panel A - 2002; panel B - 1985)
  - Paper replaced as a document dissemination medium by microform (panel A - 1996; panel B - 1984)
  - Researchers having access to data bases of validated numeric data (panel A - 2003; panel B - 1989)

## 2.3 COMPARISON BETWEEN ROUND I AND ROUND II

Since many events were rewritten following Round I, and some were eliminated, exact comparisons of results between Round I and Round II are not



possible. However, a rough comparison could be made between similar events. The "importance" parameter was not measured in Round I, thus comparison was made in terms of desirability, feasibility, and probable timing.

### 2.3.1 Desirability and Feasibility

Of the thirty-six separate events were similar enough between Round I and II to be compared, 12 were judged equally desirable and feasible by Round I and II, 18 were judged generally more desirable and feasible by Round I than Round II, and six were judged more generally desirable and feasible by Round II than Round I. However, the divergence was not extreme except in the cases of the following events:

- User organizations able to merge data bases into a single file
- Researchers having option of data analyses services through an information analysis center

Both events were judged most desirable and feasible by Round I, but only moderately desirable and least feasible by Round II.

### 2.3.2 Probable Timing

In estimates of probably timing, Round I and Round II panels were in high agreement. For 26 of the 36 comparable events the 50% probability forecast of Round I and Round II were within 5 years of each other. Of the 10 events where the results differed by more than 5 years, 6 were judged to be more proximate by Round II. However, the different estimates were considered significant (more than 10 years) for only four events:

- User organizations able to merge data bases into a single file
  (Round I: 1983; Round II = 2000+)
- Researchers having option of data analysis services through an information analysis center
  (Round I: 2000+; Round II: 1991)
- Processing of numeric data equalling bibliographic data
  (Round I: 2000+; Round II: 1984)
- Researchers having access to data bases of verified numeric data
  (Round I; 1996; Round II: 1986)

## SECTION III. CONCLUSIONS AND INTERPRETATIONS

The Expert Panel Review Task was prestructured to highlight gaps in information services and products resulting from inadequacies and unresolved problems in information technology, organizational structures and economic and marketing factors. This section summarizes the probable effects that the forecasted state-of-the-art will have on major information processing operations and plans. Specific DDC implications are pointed out as appropriate.

The interrelationships among events are presented first as a summary by area - technology, organizational structures, economics and marketing, and services; and second, as time-phased goals implied by supporting events.

These conclusions and goals are structured to provide a graphic representation of realistic expectations of technological advances that will serve to guide DDC's time phased planning to achieve new and expanded user services in the decade 1978 to 1988 (and beyond). Three time phases are referred to in the text: short range - before 1985, mid range - 1985 to 1995, long range - beyond 1995.

To sum up the results of the Expert Panel Review Task succinctly, the gaps in information services and products are not in hardware technology but in the application of technology to user needs. For example, non-bibliographic, fact retrieval services are identified as an important service gap. The forecast

indicates that advances in input techniques, communications (in the broadest sense) and standardized (or common) procedures that reduce needless dupl' ion and errors of logic or syntax will contribute to improving information services. However, advances are not likely to be dramatic.

## 3.1 TECHNOLOGY

### 3.1.1 Computer Hardware

Large scale, general purpose computers will continue to be utilized for bibliographic as well as other types of storage and retrieval in the next decade. It appears quite unlikely as well as basically unnecessary, that computer systems will be designed specifically for bibliographic applications.

Patterns are evident that indicate complete electronic control over information processing operations is desirable. The feasibility of complete control is questioned, but partial control over sub-functions is increasingly going to involve automation. The probability that technological growth will be piecemeal implies that systems will soon enter a development phase favoring decentralization and distributed processing.

Already emerging are new applications in peripherals which may be especially adapted for bibliographic and full text processing, notably optical character recognition input devices (OCR) and word processing equipment. Word processing is seen as a development particularly worth watching, since the product is then put into machine readable form at its source. OCR, by contrast, is an after-the-fact procedure of converting text to machine-readable forms. It is unlikely, however, that either process will be really widespread before the late 1980's, due to human engineering problems, incompatible equipment produced by different manufacturers, lack of standardization, unwillingness of potential buyers to commit funds, and general unsureness of how exactly to use such equipment most effectively were it to be acquired. Automatic text input devices are seen as potentially desirable and only slightly ahead of the current state-of-the-art.

Another potential and quite controversial development in peripherals is the inexpensive "personal" interactive computer terminal. Many experts see this as unnecessary and a burden on any researcher who must so cope without an intermediary to do his information searches for him. Other information pro-

fessionals foresee favorable effects including possibilities for teleconferencing. Whether or not the "personal" terminal becomes a reality, however, interactive terminals will proliferate and be more available to all researchers in the next decade. Interactive terminals and other types of peripherals may also be coupled with minicomputers (and eventually, micro computers) for applications such as data manipulation, intermediate data processing, and local data control.

A number of new computer memory technologies are being developed (holographic, "bubble," etc.) but are unlikely to affect standard data processing techniques for quite some time. Associative memories, however, (a very fast parallel-processing type of memory) are likely to be of some auxiliary use in information processing by the early 1990's. These memories, too expensive to consider for bulk storage, have a useful potential as hardware support for software "macro" instructions and for index table processing in information retrieval procedures.

### 3.1.2 Computer Software

In software, machine independence is seen as a useful trend. However, it is regarded as a mid-range achievement, delayed into the 1990's by inherent inefficiencies of machine independent software.

Purchasing software packages is seen as a desirable alternative to de novo programming. Packages with monitoring and tutorial features for on-line interactive systems can be available in the short range. The development of useful, commercial packages is regarded as feasible if DDC or similar influential agencies could define the requirements in their area and thus offer an incentive to potential vendors to develop such packages. The importance of on-line tutorial assistance is linked to the growth of personal interactive search services.

### 3.1.3 Communications

Total electronic point-to-point communication is seen as highly desirable. For example, the highest ranked event in importance was "interactive access to full text data bases replacing abstracts and indexes as searching tools." Supporting

events leading toward that all encompassing, long-range event show a set of short and mid range achievements including widespread availability of personal terminals, dial-up communication systems, electronic file transfer at reasonable cost and facsimile transmission of supporting material. In all cases, microform communication and paper were seen as limited use, interim communication media. It is probable that in the long-range, microforms will be virtually replaced by digital media with paper fulfilling a basic function unsuited to any medium other than paper. (For example, work in progress records)

### 3.1.4 Information Storage and Dissemination Media

Microform will be the prime storage medium for large bibliographic files for at least the next decade. Beginning in the 1980's, machine readable digital storage will begin to be competitive on a cost basis with paper and microform. Gradually, digital, machine readable file storage will replace present day file techniques. The probable sequence will be numeric data files first, then bibliographic surrogate files (indexes before abstracts) and ultimately full text files. However, the opinion of the members of the panel is that no media will ever completely replace or be more acceptable than paper. Therefore, DDC should always consider ways that permit individuals to select or regenerate paper copy from bibliographic system output files.

## 3.2 ORGANIZATIONAL STRUCTURES AND AFFILIATIONS

The Expert Panel Review task emphasized technology and services. Thus, only two organizational issues were submitted to panel reviews - standardization, and whether DDC should be acting as a "wholesaler" of information or a "retailer" (dealing directly with users).

Standardization events are regarded among the most important. Standardization is regarded as most desirable and feasible with standardization of citation data somewhat more feasible than standardization of abstracts. However, there is a counter-influence indicated in several events that indicate a preference for independent operations. For example, standardized vocabularies and merged data bases are regarded as relatively unimportant and only moderately desirable.



Consequently, standardization should not be viewed as part of a move toward coalescence and some form of a consolidated national system but rather as a matter of common interest to facilitate interagency communication and information exchange.

Similarly, information processing organizations acting exclusively as "wholesalers" or "retailers" is an unlikely and undesirable event. Technological and applications gaps will prevent adequate direct service to users being provided exclusively from remote, central information resources. Thus, for the foreseeable future, large processors, such as DDC, must function with a structure that permits and encourages smaller or more specialized information agencies to deal directly with users even if the central agency elects to provide some "retail" services directly to users.

Frequent and intensified cooperative efforts are forecast as desirable and feasible, particularly among agencies with complementary capabilities. For example, DDC's cooperative efforts with NASA and its plans to utilize the ARPANET to broaden its service range were cited as favorable developments.

On the questions involving interaction of data bases, the character of "independence with cooperation" was seen. Feasible events point toward developing algorithms and methodologies for translating between different data formats, thus ensuring a workable measure of compatibility without rigid interagency standardization.

## 3.3 ECONOMICS

### 3.3.1 Costs

Cost factors are not inherent barriers to advancing information technology. Notably, no event directed at cost issues was rated among the top 20% in importance regardless of the level of desirability and/or feasibility. Naturally, downward cost trends were regarded as desirable. In fact, downward costs are forecasted because of increased production and more widespread use of digital technologies which will result in lower costs per unit for hardware and software (in terms of current dollars). Communications costs will also drop, although not indefinitely.



Beyond the data of the Expert Panel Review, conjecture suggests that lower costs and more efficient hardware are insufficient and possibly inappropriate objectives as such for the information community. Despite success after success in hardware, and to a lesser extent software (much of which is a direct result of Government underwriting of development costs), the essential problems of intellectual information transfer are identified as the "important" gaps in information technology. System design problems involving machine-machine interface, man-machine interface and interorganizational interaction are consistently highlighted in the Expert Panel Review rounds.

From past experience, represented in the opinions of the panel members, quantum improvements in information processing technology will not result from more automation alone. More sophisticated, total, and human-sensitive design concepts are required than have been employed to date.

Given these conjectural circumstances, priorities for R & D funding ought to emphasize projects directed toward more effective utilization of state-of-the-art technology over developing new capabilities of hardware and software. Particularly, funding should be directed toward research, design and testing of new and more effective interactive technologies involving machine-machine interface, man-machine interface and organization-organization interface.

### 3.3.2 Source of Funding for Information Services

That federal technical information services become self-supporting is regarded as undesirable and unfeasible. Both R & D funding and operating costs are likely to require at least partial subsidy. The perception of a relationship between information services and accrued benefits is at best tenuous. Thus, efforts to achieve total cost recovery are likely to retard experimentation with new concepts and services at a time when such experimentation is seen as essential to real progress in information processing technology.

## 3.4 SERVICES

Events directed toward identifying conceptual gaps in the nature of information services received the highest ratings in importance (first and second). However, it is disappointing (as well as enlightening) that the panels

were very pessimistic about the prospects for bridging the gaps before 1995.

Three conclusions stand out:

- Access to complete information is needed (surrogates are only useful intermediate tools)
- Services have to be interactive
- Researchers need access to factual, verified data

### 3.4.1 Accessibility to Information Resources

Panelists in each of the Rounds stressed the need for users to have access to comprehensive information. It is desirable and feasible that the logical strategy to accessing comprehensive information stores appear direct and "simple" to the user. While many events imply that in the long range, total electronic control and manipulation of information processes will provide the means for accomplishing widespread comprehensive accessibility, it is forecast that to maintain the appearance of simplicity, human intermediaries will be most desirable for the short and mid range periods. The human intermediary is seen as essential . He may be an information specialist or an R & D user sophisticated in information processes who will be able to translate man-machine communication and act as a logical connecting node in an accessible, but complicated technical information community which will persist into the 1990's.

The ability to address the complete technical information record (i.e., all possible technical information files) was regarded as only one aspect of ensuring accessibility to information resources. Equally important is the ability to pursue an interactive search strategy. Broad accessibility is implied by comprehensive addressibility. Precise accessibility is provided by iteration. Thus, an interactive type of information system is the most preferred mode of operation. Interaction can exist at several levels. It usually is taken to refer to the ability of a terminal user to address and define succeeding subsets of a master file in a dialog type of interaction. More sophisticated interaction can involve machine-to-machine interaction and inter-file interaction (e.g., use of multiple files accessed in a number of independent locations) on an *ad hoc* basis.



In the long term, both broad and deep accessibility should be provided in order to provide the full scope of services required by technical information users.

### 3.4.2 Fact Services

The most conspicuous gap in information services, according to the Expert Panel Review, is fact information. Fact information includes numeric values and also pieces of discrete data capable of satisfying inquiries without further reference. The technology is estimated to be capable of supporting such a service and it is rated most desirable and extremely important. Yet, the probable timing places this as a mid to long range event.

This event must be regarded as a high-payoff area for DDC to pursue. There appears to be no explanation for the lack of progress in fact services other than neglect on the part of the information planners and designers.

### 3.4.3 Information Analysis

Information analysis, like fact retrieval, is an extension of information services that goes beyond citations and document retrieval. This, too, is an event that was regarded by the panels to be "important". However, it is interesting that it was considered to be only "moderately desirable" and "least feasible" as a service for "all researchers." It appears that information analysis is a service to be offered judiciously.

Alternative interpretations inferred from these results suggest two DDC options. DDC can build on its present referral service and become a centralized referral center for information analysis. This option requires that DDC be able to provide expert consultation on the various capabilities of information analysis centers. Computerized listings of selected names of centers meeting search parameter is not sufficient. Users need interactive dialog to be able to assess the appropriateness of various information centers for their needs of a given moment.

A second alternative is for DDC to sponsor or establish and maintain an information analysis center covering subjects of general interest or multidisciplinary fields not adequately provided for by the specialized information analysis centers currently sponsored by DoD.

## 3.5 TIME-PHASED GOALS AND SUPPORTING EVENTS

A key objective of the Expert Panel Review was to develop a time phased structure to the forecasted technological advancement of information processing. This section takes the findings and conclusions previously discussed and adds a sense of prioritization.

The two parts of this section present the events of the Expert Panel Review in terms of prioritization by relative importance and prioritization by time phased goals.

### 3.5.1 Prioritization by Order of Importance

The Expert Panel Review task resulted in a well distributed order of importance to the events submitted for review. Figure 3-1 illustrates the distribution of events according to the "importance" rating ascribed by the Round II panel. 15 events were judged "important" by 60% of the panel, 9 events by 70% of the panel and one event each by 80% and 90% of the panel, respectively.

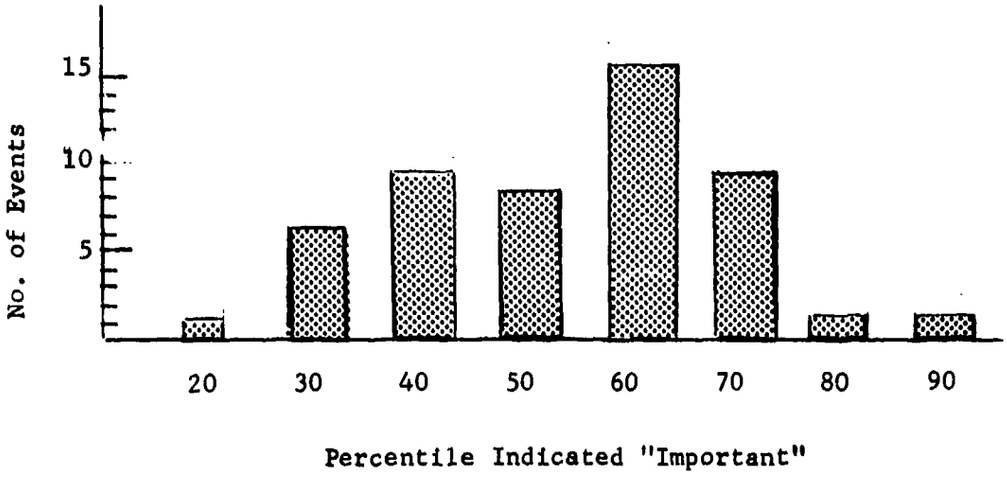


Figure 3-1. Distribution of Events by Importance

Eleven events in the 70 to 90 percentile made up the top 20% of events by importance. They also represented the down slope on the distribution curve (i.e., the above average "important" events). Thus, these 11 events, shown in Figure 3-2,were chosen as a select set, which were interpreted to be

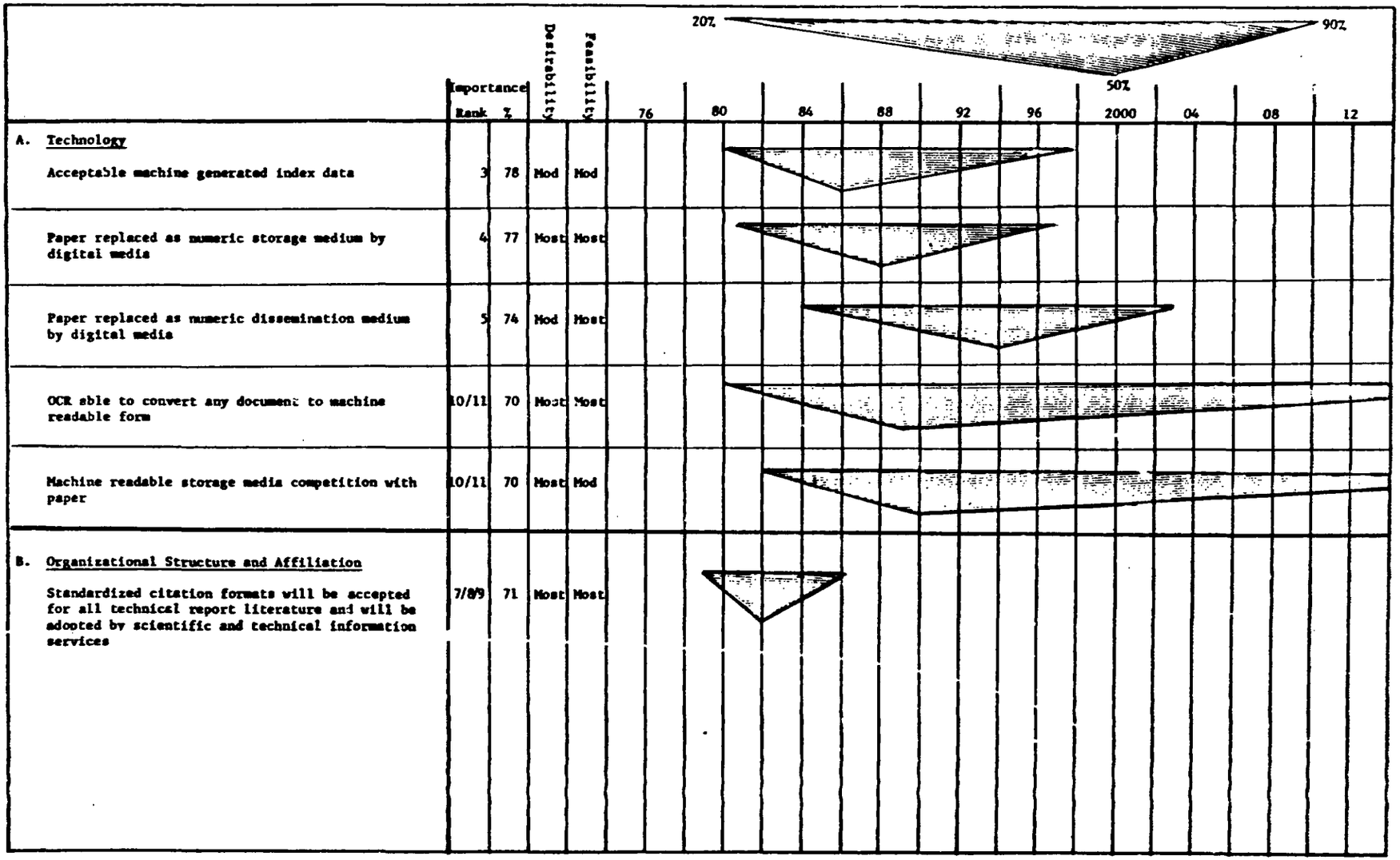


Figure 3-2. Most Important Events

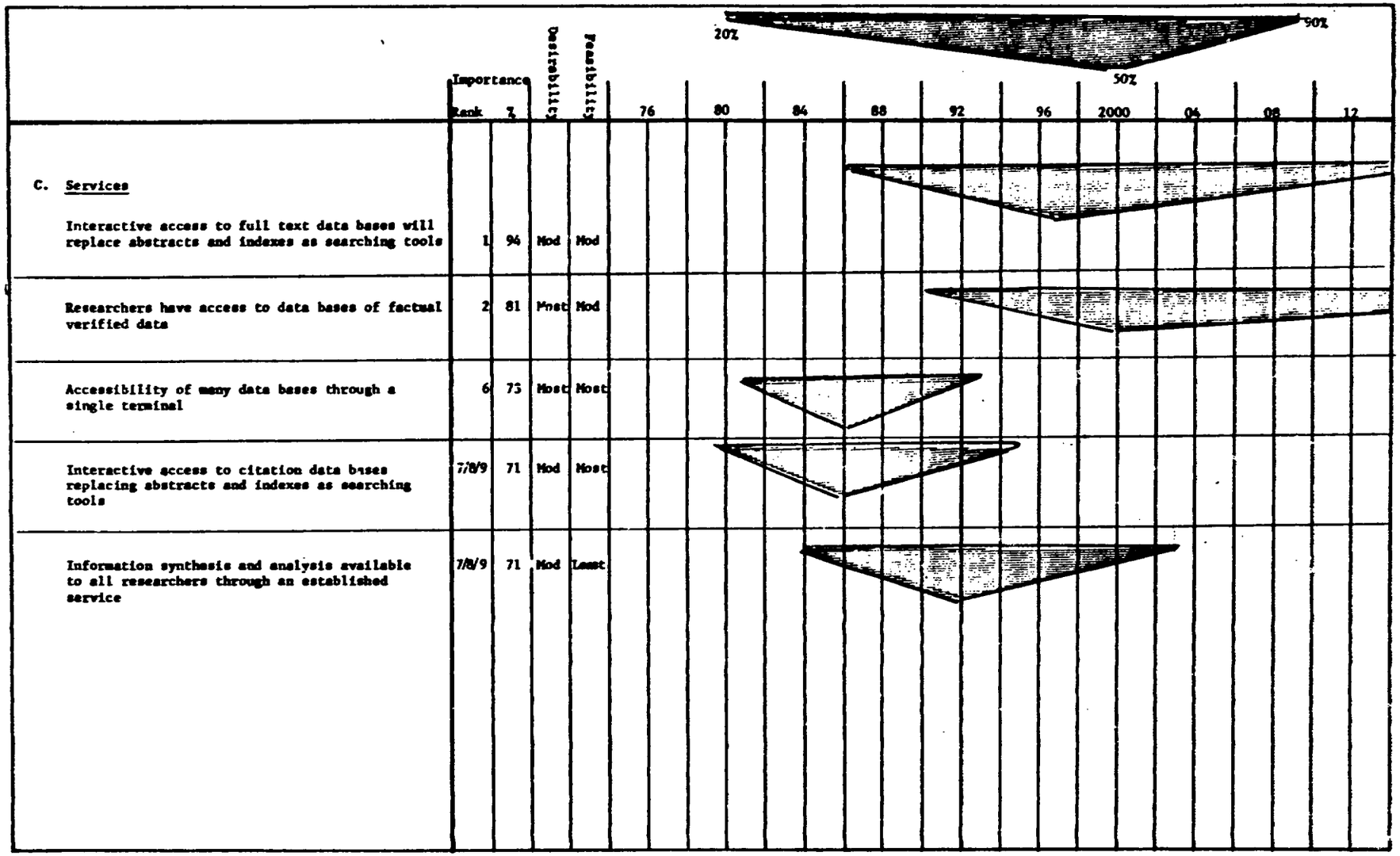


Figure 3-2. (Continued)

the appropriate events to govern the direction of information technology that would be most likely to result in quantum improvements in information processing technology.

The events are evenly distributed between technology and services with standardization achievement acting as a sort of bridge. Achievements of cost related events are notably lacking in the list of "important" events.

### 3.5.2 Time-Phased Goals and Supporting Events

Using the most important events (top 20%), four principal time phased goals are recommended that should characterize DDC's long range planning.

- Achieve complete electronic control over information processes
- Provide a comprehensive international cross disciplinary and integrated data resource that will be accessible to individuals through single access points
- Provide non-bibliographic services
- Provide information analysis services

These goals and their supporting events are shown in Figure 3-3. The order shown is by probable timing. As can be seen in the graphic representation, there is a wide range forecasted for some events. But the 50% probable timing estimated is used as a guide to planning.

As with all forecasts and most goals, unforeseen developments can alter the predicted course of events. However, until such time, the outline depicted in Figure 3-3 represents the most reasonable forecast of the course that information processing technology will take through the next several decades.



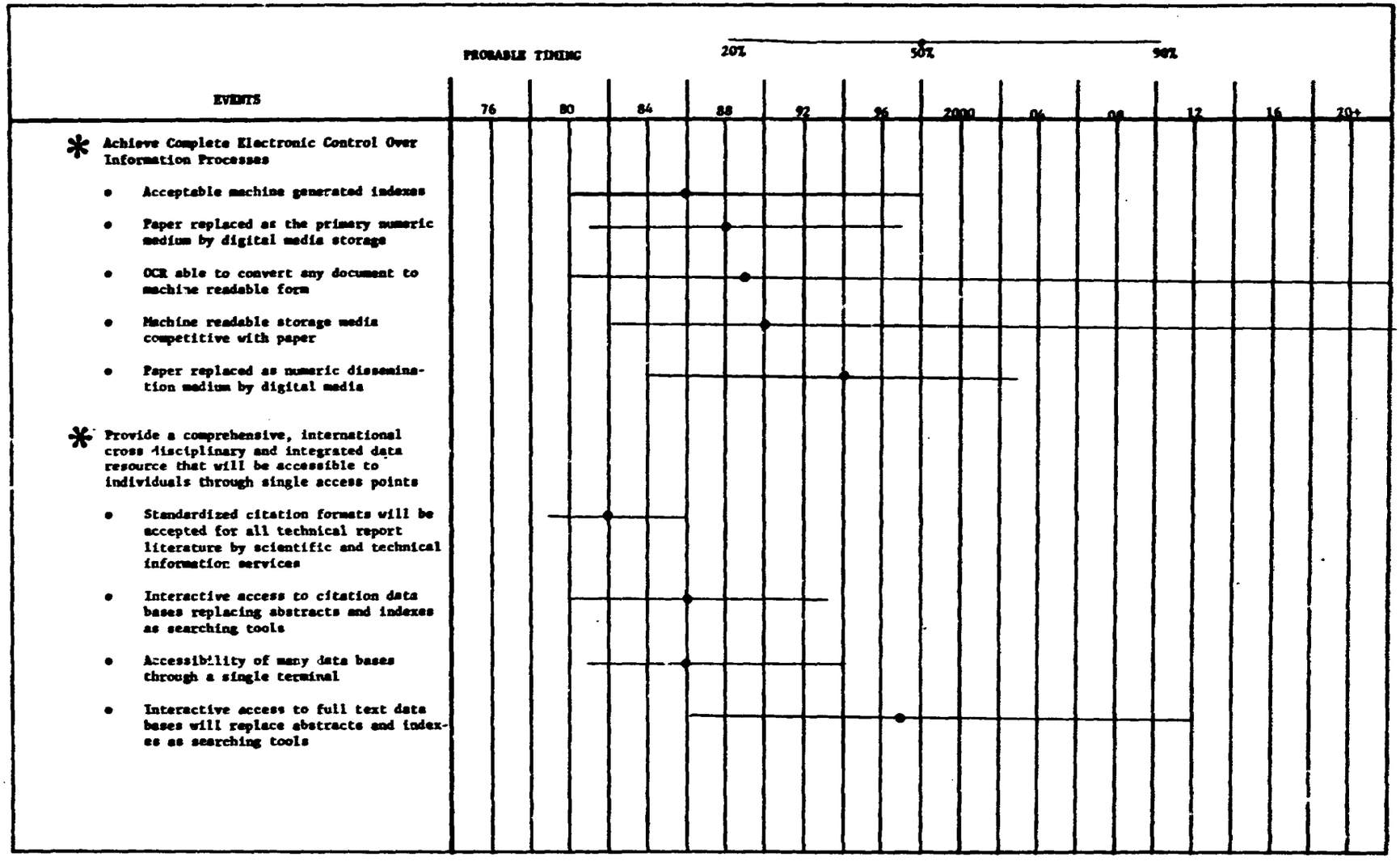


Figure 3-3. Time-Phased Goals and Supporting Events

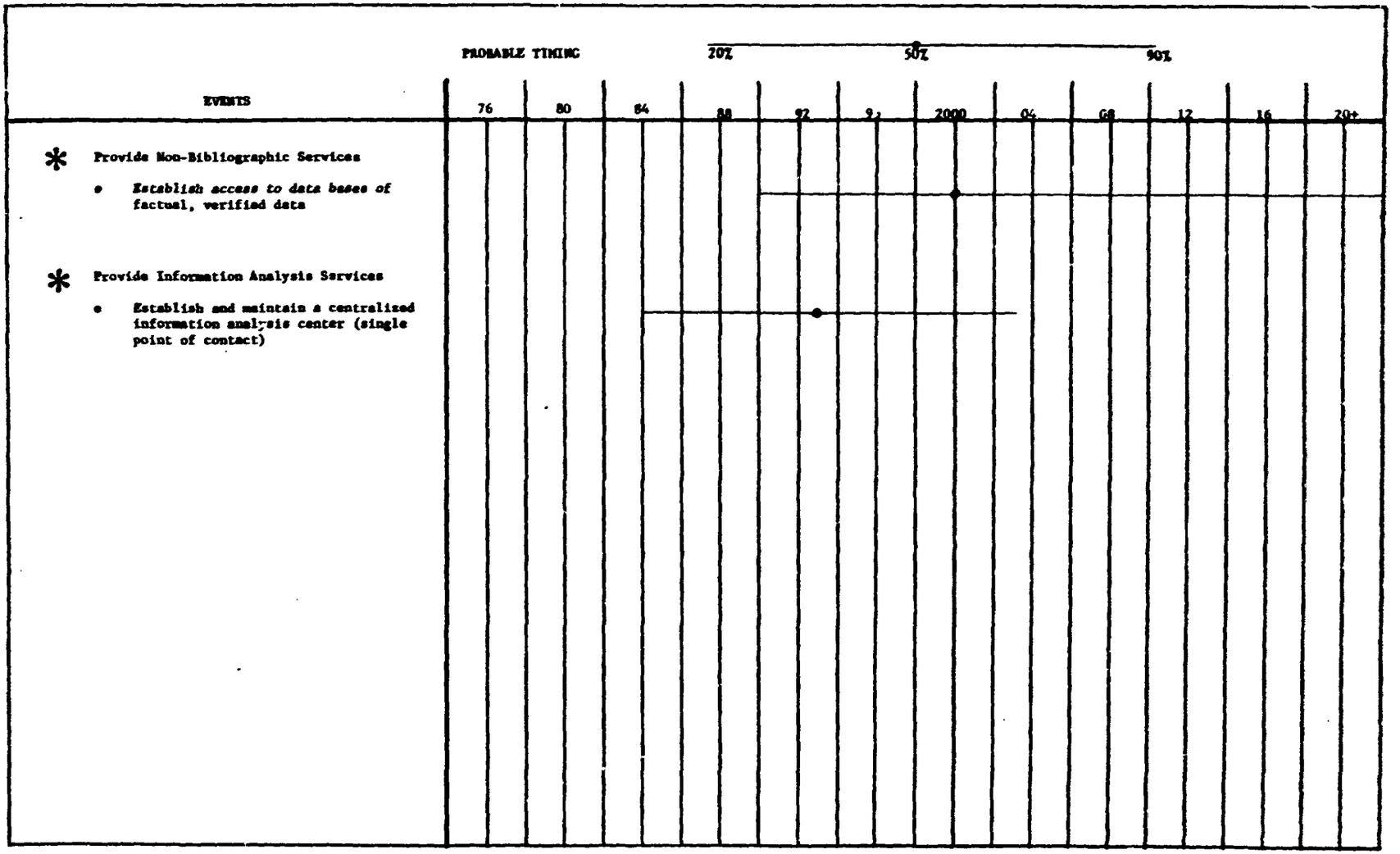


Figure 3-3. (Continued)

# APPENDIX A. DATA TABULATION

TABLE A-1 . TECHNOLOGY

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| **Most Desirable and Most Feasible** | | | | |
| 1. Most technical information retrieval by dial-up communication lines | 6 | 5 | 59% | 1983<br>1986 M<br>1990 |
| 2. Facsimile transmission competitive with postal service in cost | 13 | 10 | 50% | 1981<br>1987 M<br>1995 |
| 3. Paper will be replaced as primary numeric storage medium by digital media | 17c | 14c | 77% | 1981<br>1988 M<br>1995 |
| 4. OCR able to convert any document to machine readable form | 19 | NA | 70% | 1980<br>1989 M<br>2050 |
| 5. Word processing equipment making available machine readable full text | 20 | 19 | 68% | 1981<br>1985 M<br>1994 |
| **Most Desirable and Moderately Feasible** | | | | |
| 6. Machine readable storage media competitive with paper | 2 | 3 | 70% | 1982<br>1990 M<br>2071 |
| 7. Files electronically transferred between different locations at low cost | 7 | 6 | 68% | 1982<br>1989 M<br>1996 |
| 8. Commercial software packages replacing most original software development | 21 | 20 | 46% | 1983<br>1987 M<br>1994 |
| 9. Most packaged software machine independent | 22 | NA | 66% | 1983<br>1990 M<br>2008 |
| **Moderately Desirable and Most Feasible** | | | | |
| 10. Machine readable storage competitive with microfilm | 3 | 4 | 66% | 1982<br>1991 M<br>2003 |

S = < 1985

M = 1985-1995

L = > 1995

TABLE A-1. TECHNOLOGY (Continued)

| EVENT | A# | B# | Importance | Timing | |
|---|---|---|---|---|---|
| 11. Peripherals with minis will take over many automated functions | 8 | NA | 40% | 1979<br>1983<br>1987 | S |
| 12. Interactive computer terminals available for $500. | 10 | 8 | 60% | 1980<br>1983<br>1986 | S |
| 13. High quality, low cost microfilm reader-printer available | 12 | | 55% | 1979<br>1984<br>1988 | M |
| 14. Paper replaced as document storage medium by microforms | 14a | 11a | 44% | 1980<br>1988<br>1994 | M |
| 15. Automatic monitoring built into retrieval systems | 16 | 13 | 34% | 1976<br>1981<br>1984 | S |
| 16. Paper replaced as numeric dissemination medium by digital media | 17d | 14d | 74% | 1984<br>1994<br>2003 | M |
| Least Desirable and Most Feasible | | | | | |
| 17. Paper virtually replaced as a numeric dissemination medium by microform | 176 | 146 | 46% | 1982<br>1988<br>1994 | M |
| Moderately Desirable And Moderately Feasible | | | | | |
| 18. Associative memories commonly used for machine-aided fact retrieval | 5 | NA | 55% | 1982<br>1992<br>2000+ | M |
| 19. "Personal" interactive terminals very common | 11 | 9 | 67% | 1983<br>1993<br>2013 | M |
| 20. Paper replaced as document storage medium by full text digital media | 14c | 11c | 44% | 1985<br>1997<br>2014 | L |

TABLE A-1. TECHNOLOGY (Continued)

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| 21. Acceptable machine generated index data | 18 | 18 | 78% | 1980<br>1986 M<br>1998 |
| 22. Tutorial features of on-line systems making intermediaries unnecessary | 24 | 22 | 58% | 1981<br>1988 M<br>1996 |
| Moderately Desirable and Least Feasible | | | | |
| 23. Associative memories will be commonly used in machine aided retrieval | 4 | NA | 44% | 1984<br>1995 M<br>2000+ |
| Least Desirable and Moderately Feasible | | | | |
| 24. Paper replaced as document dissemination medium by microform | 14b | 11b | 34% | 1981<br>1990 M<br>1998 |
| 25. Paper replaced as numeric storage medium by microform | 17a | 14b | 46% | 1981<br>1988 M<br>1992 |
| Least Desirable and Least Feasible | | | | |
| 26. Computers designed specifically for bibliographic storage and retrieval | 1 | NA | 20% | 1980<br>1984 L<br>1988 |
| 27. Paper replaced as document dissemination medium by full text digital media | 14d | 11d | 65% | 1989<br>2003 L<br>2028 |

## TABLE A-2. ORGANIZATIONAL AFFILIATION

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| **Most Desirable and Most Feasible** | | | | |
| 28. Standardized citation formats | | 16 | 71% | 1979<br>1982 S<br>1986 |
| 29. Standardized abstracts formats | | 17 | 64% | 1980<br>1982 S<br>1986 |
| **Most Desirable and Moderately Feasible** | | | | |
| 30. Standardized user protocols for on-line retrieval system | 23 | 21 | 68% | 1983<br>1989 M<br>2000+ |
| **Moderately Desirable and Most Feasible** | | | | |
| 31. Two levels of information providers - wholesalers/ retailers | | 27 | 43% | 1977<br>1980 S<br>1985 |
| **Moderately Desirable and Moderately Feasible** | | | | |
| 32. Unnecessary data base duplication eliminated | | 1 | 64% | 1979<br>1983 S<br>1993 |
| **Moderately Desirable and Least Feasible** | | | | |
| 33. Standardization allowing user organizations to merge data bases into a single file | 9 | 7 | 61% | 1987<br>2000+ L<br>2000+ |
| **Least Desirable and Moderately Feasible** | | | | |
| 34. Decentralized input processing for large IS&R systems | | 2 | 36% | 1981<br>1988 M<br>2000 |

S = < 1985

M = 1985-1995

L = > 1995

TABLE A-2. ORGANIZATIONAL AFFILIATIONS (Continued)

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| Least Desirable and Least Feasible | | | | |
| 35. One interdisciplinary subject vocabulary | | 15 | 57% | 1983<br>1993 M<br>2000 |

## TABLE A-3. ECONOMICS AND MARKETING

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| **Most Desirable and Most Feasible** | | | | |
| 36. Facsimile transmission competitive with postal service in cost | 13 | 10 | 60% | 1981<br>1987 M<br>1995 |
| **Moderately Desirable and Most Feasible** | | | | |
| 37. Interactive computer terminals available for less than $500 | 10 | 8 | 60% | 1980<br>1983 S<br>1986 |
| 38. High quality, low cost microfilm reader-printer available | 12 | | 55% | 1979<br>1984 M<br>1988 |
| **Least Desirable and Least Feasible** | | | | |
| 39. Federal technical information services to become self-supporting | | 31 | 36% | 1982<br>1987 M<br>1992 |

S = < 1985

M = 1985-1995

L = > 1995

## TABLE A-4. SERVICES

| EVENT | A# | B# | Importance | Timing |
|---|---|---|---|---|
| **Most Desirable and Most Feasible** | | | | |
| 40. Accessibility of many data bases through a single terminal | 15 | 12 | 73% | 1980<br>1986 M<br>1994 |
| **Most Desirable and Moderately Feasible** | | | | |
| 41. Major IS&R systems allowing choice of output | 25 | 26 | 38% | 1982<br>1988 M<br>1997 |
| 42. Researchers have access to data bases of factual, verified data | 27 | 30 | 81% | 1990<br>2000 L<br>2000+ |
| **Moderately Desirable and Most Feasible** | | | | |
| 43. Interactive access to citation data bases replacing abstracts and indexes as searching tools | | 23 | 71% | 1980<br>1986 M<br>1993 |
| **Moderately Desirable and Moderately Feasible** | | | | |
| 44. Personal interactive terminals very common | 11 | 9 | 67% | 1983<br>1993 M<br>2013 |
| 45. Tutorial features of on-line systems making intermediaries unnecessary | 24 | 22 | 58% | 1981<br>1988 M<br>1996 |
| 46. Interactive access to full text data bases replacing abstracts and indexes as searching tools | | 24 | 94% | 1986<br>1997 L<br>2013 |
| **Moderately Desirable and Least Feasible** | | | | |
| 47. Information synthesis and analysis available to all researchers | | 28 | 71% | 1984<br>1991 M<br>2003 |

S = < 1985

M = 1985-1995

L = > 1995

## TABLE A-4. SERVICES (Continued)

| EVENT | A# | B# | Importance | Timing | |
|---|---|---|---|---|---|
| **Least Desirable and Moderately Feasible** | | | | | |
| 48. Processing of numeric data at least equal to the processing of bibliographic information | 26 | 29 | 44% | 1980<br>1985<br>1989 | M |
| **Least Desirable and Least Feasible** | | | | | |
| 49. Dissemination of full text of documents precluding need for abstracts as announcement devices | | 25a | 36% | 1986<br>1993<br>2004 | M |
| 50. Dissemination of full text of documents precluding need for abstracts as retrieval devices | | 25b | 50% | 1985<br>1991<br>1998 | M |

TABLE A-5. RANKED ORDER OF IMPORTANCE

| Event | % Indicating Importance | Event | % Indicating Importance |
|---|---|---|---|
| 1 | 59% | 26 | 20% |
| 2 | 60 | 27 | 65 |
| 3 | 77 | 28 | 71 |
| 4 | 70 | 29 | 64 |
| 5 | 68 | 30 | 68 |
| 6 | 70 | 31 | 43 |
| 7 | 68 | 32 | 64 |
| 8 | 46 | 33 | 61 |
| 9 | 66 | 34 | 36 |
| 10 | 66 | 35 | 57 |
| 11 | 40 | 36 | 60 |
| 12 | 60 | 37 | 60 |
| 13 | 55 | 38 | 55 |
| 14 | 44 | 39 | 36 |
| 15 | 34 | 40 | 73 |
| 16 | 74 | 41 | 38 |
| 17 | 46 | 42 | 81 |
| 18 | 55 | 43 | 71 |
| 19 | 67 | 44 | 67 |
| 20 | 44 | 45 | 58 |
| 21 | 78 | 46 | 94 |
| 22 | 58 | 47 | 71 |
| 23 | 44 | 48 | 44 |
| 24 | 34 | 49 | 36 |
| 25 | 46 | 50 | 50 |

RANKING BY EVENT NUMBER

| Rank | Event |
|---|---|
| 1st | 46 |
| 2nd | 42 |
| 3rd | 21 |
| 4th | 3 |
| 5th | 16 |
| 6th | 40 |
| 7th, 8th, 9th | 28, 43, 47 |
| 10th, 11th | 4, 6 |
| 12th, 13th, 14th | 5, 7, 30 |
| 15th, 16th | 19, 44 |
| 17th, 18th | 9, 10 |
| 19th | 27 |
| 20th, 21st | 29, 32 |
| 22nd | 33 |
| 23rd, 24th, 25th | 2, 12, 36, 37 |
| 26th | |
| 27th | 1 |
| 28th, 29th | 22, 45 |
| 30th | 35 |
| 31st, 32nd, 33rd | 13, 18, 38 |
| 34th | 50 |
| 35th, 36th, 37th | 8, 17, 25 |
| 38th, 39th, 40th | 14, 20, 23, 48 |
| 41st | |
| 42nd | 31 |
| 43rd | 11 |
| 44th | 41 |
| 45th, 46th, 47th | 34, 39, 49 |
| 48th, 49th | 15, 24 |
| 50th | 26 |

EVENTS BY RANK OF IMPORTANCE

TABLE A-6. DISTRIBUTION OF EVENTS BY ORDER OF IMPORTANCE

| Percentile | Number of Events |
|---|---|
| 90 | 1 |
| 80 | 1 |
| 70 | 9 |
| 60 | 15 |
| 50 | 8 |
| 40 | 9 |
| 30 | 6 |
| 20 | 1 |

# APPENDIX B. ROUND IIA AGGREGATE DATA WITH COMMENTS

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 1. Computers designed specifically for bibliographic storage and retrieval applications will be available. | 20% | 3.8 | 5.9 | 1980 | 1984 | 1988 |

Comments:

General purpose computers can do this well enough. A specialized computer system for this is unlikely. (Specialized storage peripherals, however, may be developed for this application.) Image retrieval, on the other hand (half-tone and color) will have value for bibliographic systems when this new technology expands into the future.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 2. Machine-readable storage media for text will be competitive from cost, capability and access time standpoints with paper. | 55% | 7.4 | 6.7 | 1981 | 1986 | 2135 |
| | | | | 1 "now response" | | |

Comments:

Paper will always have immense value, and some users will always prefer it. In any event, it is the display media (connected to the storage) which has the task of competing with paper. MRS based on photographic principles may be the type most competitive with paper eventually.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 3. Machine-readable storage media for text will be competitive from cost, capability and access time standpoints with microfilm. | 55% | 6.6 | 8.7 | 1979<br>1 "now" | 1984<br>response | 1991 |

**Comments:**

Electronic systems are more versatile than purely optical systems, and will replace them. To support this, microfilm will be machine readable.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 4. Associative memories will be commonly available at reasonable cost for use in machine-aided document retrieval. | 44% | 6.6 | 5.5 | 1984 | 1995 | 2009 |

**Comments:**

May be possible, with semiconductor memory technology developing rapidly, but will always be costly and will not be competitive for bulk storage. Small specialized associative memories, however, will be used to support computer macro instructions. (i.e., software support).

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 5. Associative memories will be commonly available at reasonable cost for use in machine-aided fact retrieval. | 55% | 6.8 | 6.3 | 1982 | 1992 | 2003 |

Comments:

Different Comments: 1) Same comments as 4. 2) Conventional memories are adequate in speed and competitive in cost. 3) "Modest size" (less than 100K bytes) associative memories will be used in this way. 4) Associative memories will be used heavily for index table processing in fact retrieval question and answer systems.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 6. A large majority of remote technical information retrieval will be accomplished via dial-up communication lines. The remainder will be accomplished through dedicated lines. | 40% | 7.1 | 8.3 | 1988 | 1992 | 1993 |

Comments:

Different comments: (Several respondents factored in in mail service and library service as part of "remote technical information retrieval") 1) This capability has existed since 1973. 2) Cost of communications and wide band facilities will prevent this from being economically feasible. 3) Depends on whether number of subscribers or volume of traffic is meant.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 7. Machine readable records will be electronically transferred directly from one location to another at a transmission cost per record which is competitive with currently mailing a reel of tape. | 50% | 7.4 | 6.6 | 1983 | 1992 | 2001 |

**Comments:**

1) Cost of mailing is too low, and costs of electronic transmission will always be higher. However, if speed is the issue, cost does not matter. 2) The technology exists. Communication costs are still dropping, and CPU handling costs are still in flux. 3) Physically transporting magnetic tape or a hologram will always be cheaper than electromagnetic propagation. The answer depends on distance.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 8. Minicomputers coupled with peripherals will generally take over many functions currently performed by large centralized computers in large scientific information systems. | 40% | 7.1 | 7.7 | 1979 | 1983 | 1987 |

Comments:

Different comments: 1) Large scientific programs are growing in processing requirements - minis are for local control - not computation. 2) Big computers will be transformed into mini-computer networks by 1985. 3) By 1990 it will be microcomputers.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 9. Major obstacles to standardization will be overcome, allowing scientific and technical bibliographic data bases to be merged into a single file. | 67% | 6.3 | 6.2 | 1985<br>1 "now" technol | 1993<br>response ogy asp | 2008<br>(for ects) |

**Comments:**

1) People and groups are the "obstacles" - standardization would have to be forced. 2) Standardization is not required if data bases are used by different groups. 3) The reverse will take place: data of more complex structure will evolve. 4) Storing data in standard formats is done now.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 10. Each R&D professional will be able to purchase an interactive computer terminal for less than $500. | 50% | 6.9 | 8.5 | 1979<br>1 "now" response | 1982 | 1985 |

**Comments:**

1) What about the administrative overhead, link-in, and communications costs? 2) Programmable microcomputers will be more important. By 1985, individuals will have their own data bases on cheap disc packs. 3) This terminal will have processing and logic capabilities and storage. 4) Such terminals are now available.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 11. Increased computer capacities and reduced processing costs will make personal interactive terminals as common as electric typewriters. | 70% | 5.9 | 5.8 | 1985 | 2002 | 2036 |

Comments:

1) Terminal users may not be as common as typists! 2) Will further depersonalize work. 3) Little need. Users can use calculators. Re record keeping, most individual's records aren't that complex 4) The communication costs are the bottleneck.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 12. A high-quality, low cost (i.e., under $100) microfilm reader-printer will be commercially available. (High-quality: High resolution, small size, light weight, user convenience.) | 55% | 6.4 | 7.8 | 1979 | 1984 | 1988 |

Comments:

The demand factor is the problem - high volume productions needed for lower price may not come. Also inflation will raise prices, so the cost of such equipment would not be 100 1975 dollars, but the equivalent.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 13. In terms of cost, facsimile transmission will be competitive with postal service for full text document delivery. | 43% | 7.4 | 7.4 | 1981 | 1989 | 1998 |

Comments:

1) Assuming brief documents. Don't think fax will ever compete for lengthy documents. 2) Privacy could be a problem. 3) Not clear who needs such a capability.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 14. Paper will be virtually replaced as the primary document dissemination and/or storage medium by microform and/or full text digital media. | | | | | | |
| (a) Microform: storage | 55% | 6.6 | 6.7 | 1982 | 1992 | 2004 |
| (b) Microform: dissemination | 44% | 6.4 | 6.2 | 1984 | 1996 | 2008 |
| (c) Full text digital: storage | 67% | 5.7 | 7.0 | 1987 | 2001 | 2018 |
| (d) Full text digital: dissemination | 55% | 4.4 | 5.7 | 1990 | 2006 | 2018 |
| (Please respond to all four parts) | | | | | | 1 "never" for .9 |

**Comments:**

Microforms more difficult to manipulate physically, but easier to publish. Paper has too many advantages to be "virtually replaced." Non-paper will increase markedly, but statement is too strong.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 15. Machine-readable R&D data bases will be electronically linked so that a user of any one of these data bases can, with proper authorization, directly access almost any other data base through a single on-line terminal. | 60% | 6.9 | 8.5 | 1981 | 1988 | 1988 |

**Comments:**

Done now with ARPANET. Need and economics must justify costs. "Private enterprise" factors and the number of data bases involved will slow down this development, however.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 16. Automatic retrieval systems will have built in monitoring features, thus providing instant analysis of system use and user needs. | 33% | 5.0 | 7.5 | 1975 | 1980 | 1984 |

**Comments:**

Different comments: 1) ...and automatic reporting to the authorities of stupid or dangerous requests! 2) This exists now. 3) This one isn't too big a problem.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 17. Paper will be virtually replaced as the primary numeric data storage and/or dissemination medium by microform and/or digital media. | 37% | 5.8 | 7.1 | 1980 | 1987 | 1994 |
| (a) Microform: storage | 50% | 6.2 | 7.5 | 1981 | 1988 | 1995 |
| (b) Microform: dissemination | 62% | 7.2 | 8.6 | 1982 | 1989 | 1998 |
| (c) Digital media: storage | 62% | 6.7 | 8.0 | 1987 | 1988 | 2005 |
| (d) Digital media: dissemination | | | | | | |
| (Please respond to all four parts of the question) | | | | | | |

Comments:

1) Hand-held calculator/numeric stores will completely replace paper for computation as soon as available. 2) "Same comments as 14"

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 16. For scientific and technical report literature, the machine-generation of use-acceptable index data from machine readable text will virtually eliminate the need for manual indexing. | 50% | 7.5 | 7.3 | 1980 | 1987 | 2005 |

**Comments:**

1) Only if author or editor provide key words/phrases or abstract. 2) Just as in language translation, a lot of human oversight (sic) will be needed to provide the context. 3) Problems: defining the structure into which the index is to fit; analysis of contextual connotations.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 19. Optical character recognition devices will readily convert virtually any document to machine-readable form, regardless of format or type font, with accuracy of 95% or better. | 70% | 8.5 | 7.8 | 1980 | 1989 | 2050 |

Comments:

1) How could a machine read mathematical diagrams and formulas? These could, of course be treated as pictoral data. 2) Not handwritten material. 3) Not sure such versatility of formats and type-fonts may not be necessary in most applications. 4) Including pictoral art? Graphic OCR has a later set of probability dates.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 20. Increased use of word processing equipment will make machine-readable versions of full text documents readily available. | 67% | 8.2 | 7.7 | 1981 | 1986 | 1996 |

**Comments:**

1) The coming office revolution. 2) Implies cooperative effort to index, store, maintain, etc. which I am not sure will ever take place except by decr e

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 21. Use of commercially available software packages for virtually all but the most specialized document storage and retrieval applications will replace almost all original software development. | 50% | 7.5 | 8.3 | 1985 | 1990 | 1999 |

**Comments:**

1) Political question. Can technically be done today. 2) Would require and encourage standardization, which is probably the only hope for ever achieving widespread existence of "electronic libraries." 3) The "NIH" effect will slow this down. ("Not Invented Here")

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 22. Almost all packaged software will be machine independent. | 60% | 8.1 | 6.7 | 1983 | 1990 | 2008 |

**Comments:**

1) May be technically feasible now, but not very attractive economically (to the computer industry)
2) Certain classes of software (high level languages) - now. Differences in system architecture will preclude complete machine independence of all software in the near future.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 23. Standardized user protocols for on-line interactive retrieval systems will be adopted by all technical information services. | 67% | 8.6 | 7.2 | 1984 | 1992 | 2012 |

**Comments:**

1) Whose standards? Such standards might limit future advances. 2) Political pressure would have to effect this.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 24. Conversational and tutorial on-line retrieval systems will evolve to the point where human intermediaries between the system and the requestor will usually become unnecessary. | 60% | 6.6 | 7.3 | 1980 | 1987 | 1999 |

Comments:

1) The capability to do this is essentially available, as in certain medical diagnostic instruction programs. Someone must pay for the development. 2) While intermediaries may not be strictly "necessary" they often will exist to allay frustration on the part of users without the necessary patience.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 25. Almost all major R&D information systems will permit the user to specify his own format, with few limitations on data order or structure. | 40% | 8.0 | 6.8 | 1983 | 1991 | 2004 |

**Comments:**

1) Standards will force user to conform to system requirements. 2) Data base techuiques are available now. It may not be economically feasible to implement such freedom, however. 3) May be more expensive than it is worth. May also require more user specifications than worthwhile.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 26. In the R&D environment, the collection, storage, and retrieval of numeric data will at least equal, if not surpass, in volume and importance, the processing of bibliographic information. | 28% | 4.4 | 6.4 | 1979<br>2 "now" responses<br>1 "never" response | 1983 | 1987 |

**Comments:**

1) Numeric data is subset of text, or descriptive, data - we cannot interpret numerics unless we know what they describe. 2) Importance, but not volume. 3) Depends on end use. Engineering may need only numeric data. 4) I haven't the foggiest idea how to assess the relative importance of numeric and bibliographic information. 5) Can't imagine why. Numeric data is only really useful in formulating and verifying hypotheses. 6) Seems to me we are already these.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 27. Most R&D scientists will have access to discipline-oriented data bases of highly select, certified and validated *numerical* data, largely supplanting bibliographic references to reported results and collections of unverified data. | 70% | 7.4 | 5.6 | 2003<br>1 "now" response<br>1 "never" response for .9 | 2033 | 2172 |

**Comments:**

1) Masses of numeric data: OK for validcting theory, etc. but would seem to me to deemphasize new theories or techniques for which there is no mass of supporting data. Who will define what data is to be collected, etc.? 2) What's to stop "GI-GO,"* just because it's computerized? 3) Can have it now, if they can convince management. 4) "Most" researchers do not trust data gathered by others. How "validated?" 5) All scientific data is subject to further investigation. If you label it as "certified and validated," there is no further need for science.

* *Garbage in, garbage out*

# APPENDIX C. ROUND IIB AGGREGATE DATA WITH COMMENTS

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 1. Unnecessary duplication in acquisitions among major bibliographic data bases will be virtually eliminated through inter-organizational agreements. | 64% | 7.2 | 7.1 | 1979 | 1983 | 1993 |
| | | | | 1 "neve .9 | r" response for | |

**Comments:**

1) May be of short range economy, as publishers raise prices to offset decreased revenue from fewer subscriptions 2) Some duplication necessary and desirable. Will be monitoring from here on to reduce most unnecessary overlap. 3) Contention: what is "unnecessary" 4) Need different indexing (e.g. for different audiences.) 5) Some duplication necessary because the slant of the discipline must be interpreted and analyzed by a subject specialist. 6) Means less tailored indexing and abstracting: help control cost (but) may act to freeze out newcomers and restrict innovations. 7) Some duplications will be desirable, but not necessary.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 2. Input of information to large IS&R systems (e.g., DDC, NTIS, NASA, etc.) will be decentralized, with standardized abstracting, indexing, and data conversion provided at the local source level. | 36% | 4.8 | 6.3 | 1981<br><br>1 "never" response for .9<br><br>1 "infinity" response | 1988 | 2000 |

**Comments:**

1) It may prove very desirable to input online to central location via telecommunications. 2) Authors and institutions will probably never be good "document processors." 3) The event here is the achievement of compatible or standardized data elements formats and contents. 4) Only if centralized quality control. 5) Data conversion always partially centralized. 6) Problems: training costs, standardization. 7) Lowest common denominator of quality. 8) If decentralized, it will go all the way to the user. 9) Managerial problems are substantial. 10) Will be an interactive process involving both central and local people.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 3. Machine-readable storage media for text will be competitive from cost, capability and access time standpoints with paper. | 86% | 8.3 | 6.9 | 1983 | 1994 | 2008 |

**Comments:**

1) Determined on an individual document basis. Costs and materials priorities are unknown factors. The technology is here now. 2) Journals,not reprints. 3) Only a matter of time. True now in some areas.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 4. Machine-readable storage media for text will be competitive from cost, capability and access time standpoints with microform. | 77% | 7.5 | 6,8 | 1985 | 1996 | 2016 |
| | 13 | responses | | | | |

**Comments:**

1) Not the technology, but feasibility. Experiments and new developments may make a change here. Individual document and archive files are matters of differing aspects. 2) Not possible to consider "cost, capability and access time" in the same breath. 3) Journals, not reports. 4) Feasibility depends on relative emphasis given to (a) cost, (b) system capabilities and (c) accessibility 5) In terms of actual access, on the average, paper better than microform.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 5. A large majority of remote technical information retrieval will be accomplished via dial-up communication lines. The remainder will be accomplished through dedicated lines. | 78% | 8.3 | 8.8 | 1978 | 1981 | 1987 |
| | 14 responses | | | 2 "now" responses | | |

**Comments:**

1) The first sentence is true now. However, there will always be some local batch work. 2) Dial up to record concentrators, then dedicated lines. 3) Hesitancy may be result of security problem. 4) Most remote IR is now dial-up. 4) NOT dial-up. Through local networks connected to global networks.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 6. Machine readable records will be electronically transferred directly from one location to another at a transmission cost per record which is competitive with currently mailing a reel of tape. | 86% | 8.8 | 8.3 | 1980 | 1985 | 1990 |
| | 14 responses | | | 1 "now" response | | |

**Comments:**

1) Does "competitive" attach a $ value to time? Makes a big difference. 2) Highly desirable when speed is important. More important for numeric; less important for bibliographic. 3) For many purposes, this would be a major event unless mail service deteriorates to the pony express level! 4) But for shorter records, more feasible and sooner!

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 7. Major obstacles to standardization will be overcome, allowing scientific and technical bibliographic data bases to be merged into a single file. | 57% | 5.7 | 5.6 | 1989 | 2080 | * |
| | | | | * Only 5 dates given<br>1 "now" response<br>1 "infinity" response<br>1 "never" response | | |

**Comments:**

1) Major problem is intellectual analysis involved in the indexing of the literature from the different data bases. 2) No need for this. Value enough of different processing viewpoints and multiple separate data bases. 3) Costs attendent with maintaining and searching a huge data base: too high. Segmented files more economical. 4) Not useful because mission-oriented emphasis would be lost; vocabularies would not be compatible. 5) Assume you mean merger of those parts an agency would need. 6) Policy, politics, ownership are slow to evolve. 7) Organizational/political problems present chief barrier. 8) Assume "most" enough to make global system very useful.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 8. Each R&D professional will be able to purchase an interactive computer terminal for less than $500. | 71% | 7.8 | 8.2 | 1980 | 1984 | 1987 |
| | 14 responses | | | | | |

**Comments:**

1) Almost here. 2) Don't believe this is a real requirement. 3) Not that I can see a lot of professionals doing this very soon. 4) Depends on characteristics of the terminal. Probably can get something for that amount. 5) For searching: intermediaries will play an important role, so terminal not necessary. For teleconferencing, its a different matter. Even here access to a terminal may be sufficient. 6) But why purchase? Most R&D people will have access to the employer-supplied terminal selling for less than $500 (or the equivalent in rental). 7) Cost to manufacturer is a cinch. Price another matter.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 9. Increased computer capacities and reduced processing costs will make personal interactive terminals as common as electric typewriters. | 64% (14 responses) | 7.8 | 8.3 | 1980 | 1985 | 1991 |

**Comments:**

1) Don't believe this is a real requirement. 2) "Will" should be "could". Few professionals use electric typewriters themselves. 3) More important that they be much more widespread!

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 10. In terms of cost, facsimile transmission will be competitive with postal service for full text document delivery. | 78% | 8.6 | 7.9 | 1980 | 1985 | 1991 |
| | 14 responses | | | | | |

Comments:

1) Given the problems of the Postal Service, this may come sooner than I think it will. 2) May be more practical to use high-speed transmission/receiving "mini's" with local printing. Personal messengers may soon be competitive with postal service! 3) Very desirable; state-of-the-art just not available. 4) Sending from large centers will be easier, but the (low load) users will need low cost equipment. Yet since users are large in number, mass-market economies may make this possible. 5) Fundamentally inefficient. A blind alley.

| | | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|---|
| | | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 11. Paper will be virtually replaced as the primary document dissemination and/or storage medium by microforms and/or full text digital media.<br><br>(a) Microforms: storage<br>(b) Microforms: dissemination<br>(c) Full text: storage<br>(d) Full text: dissemination<br><br>(Please respond to all four parts of the question) | (a) | 33% | 6.0 | 8.5 | 1978<br>1 "never" for .9 | 1983 | 1985 |
| | (b) | 25% | 5.2 | 8.5 | 1978<br>1 "never" for .9 | 1984 | 1988 |
| | (c) | 92% | 6.9 | 7.0 | 1984 | 1994 | 2010 |
| | (d) | 75% | 5.5 | 6.0 | 1987 | 2000 | 2040 |
| | | 12 responses | | | | | |

**Comments:**

1) In the R&D environment and for non-book literature. The book will always be with us. It is very efficient. 2) Data capture: i.e., data entry of full text may be too costly and difficult to standardize. For material generated by computer processing, full text will be available. 3) For (d): only on demand basis and not for current awareness purposes. 4) I do not see "virtual replacement" of paper before the year 2000. 5) The technology is here. Psychology, feasibility is in question. Massive resistance will delay microforms until digital tables over. 6) Full text storage will give microforms only in short span of viability. 7) I doubt that print or paper will be completely replaced in any form. 8) Assume document = technical report, not journal articles. 9) Paper good for local dissemination if "more use" is reading.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 12. Machine-readable R&D data bases will be electronically linked so that a user of any one of these data bases can with proper authorization, directly access almost any other data base through a single on-line terminal. | 86%<br>14 responses | 9.4 | 8.9 | 1981<br>2 "now" | 1985<br>responses | 1990 |

**Comments:**

1) We have this now, essentially. 2) Essentially here except for a few major data bases such as OCLC which require special terminals or communications links. 3) Not economically feasible for the manufacturer. 4) Now possible through Tymshare. 5) Not clear whether one-terminal access is what we are rating or "electronically linked" is what question is asking about.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 13. Automatic retrieval systems will have built-in monitoring features, thus providing instant analysis of system use and user needs. | 36% | 8.0 | 8.6 | 1977 | 1981 | 1984 |
| | 14 responses | | | | | |

**Comments:**

1) Correlation of user needs and use of systems has not been established. 2) Privacy must be considered: the technology is here. 3) Now available in many cases. 3) Analysis of system use and user needs incurs different levels of difficulty to implement. 4) Privacy for users will prevent much of this as regards "subjects" but not as regards other use factors. 5) Monitoring should only be done when privacy can be guaranteed and when specific objectives for monitoring have been clearly thought out. 6) "Big brother" is the danger here. 7) Now, in R&D systems

| | | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|---|
| | | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 14. Paper will be virtually replaced as the primary numeric data storage and/or dissemination medium by microform and/or digital media. | (a) | 36% | 5.4 | 7.8 | 1980 1 "never" | 1985 response | 1990 for .9 |
| | (b) | 43% | 4.5 | 8.0 | 1982 1 "never" | 1988 response | 1993 for .9 |
| (a) Microforms: storage<br>(b) Microforms: dissemination<br>(c) Digital media: storage | (c) | 93% | 7.9 | 7.9 | 1979 | 1987 | 1996 |
| (d) Digital media: dissemination | (d) | 86% | 7.0 | 7.2 | 1981 | 1990 | 1998 |
| (Please respond to all four parts of the question) | | 13 responses | | | | | |

Comments:

1) For (d): only on demand basis; not for current awareness. 2) I assume that (d) makes sense when combined with ability to simultaneously operate on such data. 3) In the U.S. this may come sooner than worldwide.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 15. A single standard, interdisciplinary subject indexing vocabulary adopted for use by all the major information services. | 57%<br>14 responses | 3.6 | 3.1 | 1983 | 1993 | 2000<br>1 "infinity" response<br>1 "never" response for .9 |

**Comments:**

1) Language does not permit. Also no need to search across broad disciplines on all searches as would be implied in this proposition. 2) Highly doubtful that this will occur. I think it more likely that "translations" will automatically be made from one indexing vocabulary to another on-line. 3) Never happen. 4) Hard to contemplate - doubt it will occur. 4) Not even desirable. 5) A disservice to users. At least a number of vocabularies would be preferable, with switching to be signalled where needed. 6) Requires organization. Like stopping a war.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 16. Common, standardized citation formats for all technical report literature will be adopted by all scientific and technical information services. | 71% 14 responses | 7.8 | 8.1 | 1979 | 1982 | 1986 |

**Comments:**

1) In U.S., seems very probable. 2) Whether you mean data elements captured or their announcement in announced records (sic), there will probably always be differences. No need for conformance to one mold. 3) Government and standards groups should work toward this kind of standardization. 4) ANSI has such a format in draft. 5) "All" not good in such a survey.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 17. Common, standardized formats for abstracts for all technical report literature will be adopted by virtually all scientific and technical information services. | 64% | 7.9 | 7.6 | 1980 | 1982 | 1986 |
| | 14 responses | | | 1 "infinity" response | | |

**Comments:**

1) Never happen. Why should it? 2) ANSI has a standard which, if used, makes this feasible.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 18. For scientific and technical report literature, the machine generation of user acceptable index data from machine readable text will virtually eliminate the need for manual indexing. | 78% | 6.7 | 6.3 | 1980 | 1985 | 1993 |
| | 14 responses | | | 1 "infinity" response | | |

**Comments:**

1) Manual editing will still be needed. 2) Probably always be some need for human "enhancement" of the available text, for indexing purposes. 3) Machine indexing is still not totally satisfactory or cost effective. Techniques have been around for the last 10 years and we still have not been able to replace the manual indexes. 4) Acceptable is the big "if". But economies may lower standards. 5) Like machine translation, will only be done as aid to indexing. Could get up to 80-90% efficiency, but will need to use human intellectual analysis for many years. 6) Feasible earlier, but perhaps not very high priority.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 19. Increased use of word-processing equipment will make machine readable versions of full text documents readily available. | 71% | 8.1 | 7.9 | 1980 | 1984 | 1992 |
| | 14 responses | | | | | |

Comments:

1) Only for local text editing purposes. Not for use by information centers. 2) To reproduce multiple copies of full text will still involve present costs. 3) Much available now, but will be a long time before economical to search from full text. 4) "Readable" not "understandable"

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 20. Use of commercially available software packages for virtually all but the most specialized document storage and retrieval applications will replace almost all original software development. | 43%<br>14 responses | 6.0 | 6.6 | 1981<br>1 "infinity" response<br>1 "never" for .9 | 1983 | 1989 |

**Comments:**

1) Question not very clear; I don't see the need or likelihood for, say, MEDLINE to be replaced by commercial software. 2) What a big job that would be. 3) Needed for very long time.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 21. Standardized user protocols for on-line interactive retrieval systems will be adopted by all technical information services. | 71%<br>14 responses | 7.8 | 6.2 | 1981 | 1986 | 1994 |

Comments:

1) There will be a standardized subset of commands with additional system-specific commands. Much as with standardized indexing systems today. 2) Due to human nature, "translation" from one protocol to another will probably be used instead. This seems to be a particularly difficult area to gain acceptance of any standard. 3) Very desirable: would eliminate redundant training of searchers and would promote a wider use of the retrieval system. 4) Assume retrieval of bibliographic information only, other retrieval protocols will have to vary according to user kind and need. 5) Standardization should not prevent optional procedures. 6) May be more than one standard, permitting user to choose.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 22. Conversational and tutorial on-line retrieval systems will evolve to the point where human intermediaries between the system and the requestor will usually become unnecessary. | 57% | 7.4 | 5.3 | 1982 | 1989 | 1993 |
| | 14 responses | | | 1 "infinity" response<br>2 "never" responses for .9 | | |

Comments: 1) Probable that experienced intermediary will always do a better job than the requestor, given the ability of the requestor to define his needs. If requestor doesn't know what he wants, he will do a better job. 2) Essentially true now. But other factors: access time/costs, terminal sophistication level of standardization, frequency of search needs, desire of users to do it themselves. 3) Don't expect it soon. 4) More cost effective to have searchers handle all routine SDI queries and searches involving a number of data bases. 5) Don't think user will ever want to bother learning protocols and structure of data bases other than his own specialty. 6) Systems will become easier to use, but for more complex questions there will always be a role for the skilled intermediary. 7) Traffic load will result in an increasing market for intermediaries and also a smaller proportion of searches involving intermediaries. 8) Would take lots of education in the school system to prepare the population for such use.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 23. In an R&D environment, interactive on-line access to data bases of bibliographic citations will virtually (i.e., 90%) replace the abstracting and indexing journal in paper form as literature searching tools. | 71% (14 responses) | 7.3 | 7.9 | 1980 | 1986 | 1993 |

Comments:

1) Assume searching of current literature. Doubt that large back files will ever be put on-line. 2) Factors other than technical feasibility make this unlikely. 3) On-line access usually limited to last few years; as storage becomes cheaper, more data may be maintained on-line. It may, however, be more cost-effective to do some searches batch for some time. 4) In a few years 50%, but the 90% point is a sticker. 5) Costs would have to drop drastically. 6) In this U.S. only. 7) Abstract in digital form also necessary.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 24. In an R&D environment, interactive on-line access to full text data bases will virtually (i.e., 90%) replace the traditional abstracting and indexing journal in paper form and literature searching tools. | 93%<br>14 responses | 6.2 | 6.3 | 1986 | 1997 | 2013 |

**Comments:**

1) Doubt full text will be needed. I think the trend will be toward synoptic literature: citation plus abstract plus some data, for example. 2) If you mean total document text, never happen. 3) Full text data bases not cost effective for most situations. Unlikely.

| | | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|---|
| | | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 25. Low cost, rapid dissemination of full text of documents will preclude the need for abstracts as document:<br><br>(a) announcement device<br>(b retrieval device | (a) | 36% | 3.0 | 5.4 | 1986 | 1993 | 2004 |
| | | | | | 2 "never" responses | | |
| | (b) | 50% | 4.7 | 5.8 | 1985 | 1991 | 1998 |
| | | 14 responses | | | | | |

**Comments:**

1) The abstract is necessary and desirable in "screening" for relevancy, irrespective of availability of full text. 2) Will always be a need for pre-digested forms of a document. 3) We could drown in the information overload. 4) Unlikely because of resultant mountain of material. 5) Abstracts will continue to serve as effective announcement device. 6) Don't think full text can be an "announcement device" 7) May come about because of ignorance.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 26. Almost all major R&D information systems will permit the user to specify his own output format, with few limitations on data order or structure. | 36% | 7.9 | 7.8 | 1981 | 1984 | 1990 |
| | 13 responses | | | | | |

**Comments:**

1) Greater flexibility in report generation is already being noted. 2) Faster in R&D centers.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 27. Two tiers of information providers will emerge and be clearly definable: those large information services which wholesale their products to local libraries and service centers; and local activities which 'retail' their products directly to end users. | 43% | 7.0 | 7.8 | 1977 | 1980 | 1985 |
| | 13 responses | | | 1 "infinity" response | | |

Comments:

1) Already common in the regional medical library system - makes sense for bibliographic information services. Does not seem as relevant to numeric data base services. 2) As yet not known if NASIC-like groups will remain as third tier. 3) I don't think this is exactly the way things will go. 4) In U.S. only. 5) There is much evidence of this now. Am I missing something here?

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 28. Most (more than 80%) R&D personnel will have the option of requesting detailed analysis and synthesis of the literature of their discipline through an established service, such as an information analysis center. | 71% | 7.4 | 5.3 | 1984 | 1991 | 2003 |
| | 14 responses | | | | | |

Comments:

1) Economic barriers. 2) Cost problems because of heavy human effort. 3) These services are very expensive, so not likely IAC's will continue to grow. They are important, but unless the value of information services is recognized, these services will continue to be slighted. 4) Unlikely and unnecessary. 5) Expensive! 6) Would eliminate "browsing" fullout and serendipity; both are important benefits. 7) The "more than 80%" shoots the feasibility way down. There won't be enough IAC's unless more funding available from convinced users. 8) Much being done now in partial analysis. Synthesis to what degree or level?

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 29. In the R&D environment, the collection, storage and retrieval of numerical data will at least equal, if not surpass, in volume and importance, the processing of bibliographic information. | 58% | 6.3 | 7.2 | 1980 | 1986 | 1990 |
| | 13 responses | | | 1 "never" response for .9 | | |

Comments:

1) The comparison is meaningless unless there is a comparison. 2) Just not likely: importance, perhaps. Volume, no. 3) Unlikely. 4) Limited by technology as yet (large memories) 4) Seems to be an "in" trend. Personally, I think it will overshoot its mark. There will be lots of numbers available without adequate context, once the "bibliographic" tie-ins get ignored. 5) Bibliographic (textual) information is an essential component of numeric data. For numeric data to be understood have to have textual elaboration. However, would be desirable for balance between text and numeric information in documents to shift more toward the numeric. 6) Concepts and subjects will always be more important than data. 7) Alphanumeric, but non-bibliographic

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING | | |
|---|---|---|---|---|---|---|
| | | | | Year by which the probability is x that the event will have occurred. | | |
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 30. Most R&D scientists will have access to discipline oriented data bases of highly select, certified and validated numerical data, largely supplanting bibliographic references to reported results and collections of unverified data. | 93% | 8.5 | 6.9 | 1982 | 1989 | 1995 |
| | 14 responses | | | | | |

**Comments:**

1) Problems: validation of the data. Must be done by recognized experts in the field, and these people are not always available. 2) Exists in part now. 3) Expensive! 4) I believe bibliographic references will not be largely supplanted. Also there'll have to be a lot more work on certifying and validity. 5) "Access" may be highly desirable, while "supplanting" may not be. 6) Confused by limitation to numeric data. On-line numeric data can never supplant most bibliographic references.

| | Major Event? (x or o) | Desirability (on scale 1-10) | Feasibility (on scale 1-10) | PROBABLE TIMING: Year by which the probability is x that the event will have occurred. | | |
|---|---|---|---|---|---|---|
| | | | | x = 0.2 | x = 0.5 | x = 0.9 |
| 31. Federal technical information processing and dissemination activities will become virtually self-supporting. | 36% | 5.8 | 4.9 | 1982 | 1987 | 1992 |
| | 14 responses | | | 1 "never" response | | |

**Comments:** 1) Self support, in lieu of specific enacting legislation is highly undesirable for government agencies in that it encourages competition at high cost with alternative services and a spirit of entrepreneurship in agency heads in place of a more desirable fiduciary motivation. Government can always do it "cheaper" because of the way costs are derived. 2) Government, like industry, must cut back on non-justifiable expense on information. The best way to accomplish this goal is to require self-support. Hopefully this would encourage agencies to limit acquisitions to those for which there is a market and for definite need. 3) Don't think it could be done if optimum service. 4) May never happen and not necessarily desirable. 5) How can the government become self-supporting? Even if the services charge their users, the users' resources are still those of the government. 6) Never happen. 7) Information has been provided free of charge, it has been the American Way. We have not learned of the value or the ability to evaluate and put a price on information. It would be desirable to make these activities self-supporting - that way valuable services will be supported and useless ones will not. 8) Can the Library of Congress ever expect to become self-supporting? 9) Most people think it's desirable.

# APPENDIX D. QUESTIONS AND ISSUES RELATED TO THE EVENTS

I. TECHNOLOGY

| | |
|---|---|
| Question: | Can DDC obtain a computer system which is specially designed for IS&R? |
| Event: | Computers designed specially for bibliographic storage and retrieval applications will be available. |
| Question: | Will the digital storage medium become competitive with paper and microforms? |
| Event: | Machine-readable storage media will be competitive from cost, capacity, and access time standpoints, with:<br>(a) paper<br>(b) microform |
| Question: | Can associative memories be used for machine-aided information analysis and/or retrieval? |
| Event: | Associative memories will be commonly available for use in machine-aided<br>(a) retrieval<br>(b) information analysis |
| Question: | Is DDC's decision to pursue dial-up access to unclassified information sound? |
| Event: | 85% of remote technical information retrieval will be accomplished via dial-up (public switched) communications lines. The remainder will be accomplished through dedicated lines. |
| Question: | Can entire data files be electronically transferred between DDC, NTIS, IAC's, users, etc? |
| Event: | Files, (of the size equivalent to a reel of magnetic tape) will be electronically transferred directly from one data base to another at a transmission cost which is competitive with mailing a reel of tape. |
| Question: | Will the trend be away from large, centralized processing systems and toward distributed processing with minicomputers? |
| Event: | Processing in large scientific information systems will be performed by a network of decentralized minicomputers rather than by large, centralized computers. |

| | |
|---|---|
| Question: | Will computers be able to support a sufficient number of terminals to provide a CRT to each user who wants one? |
| Event: | Increased computer capacities and reduced processing costs will allow each R&D professional to have his own on-line interactive terminal. |
| Question: | What factors will influence the acceptability of microforms? |
| Event: | A high-quality, low cost (i.e., under $100) microfilm reader-printer will be commercially available. |
| Event: | Microforms will become equal to paper in acceptability by information users. |
| Question: | What are the alternatives to the postal service for document delivery? |
| Event: | Facsimile transmission will be competitive with postal service for full text document delivery in terms of cost and speed. |
| Question: | Will paper cease to be the primary document storage and dissemination medium? |
| Event: | Paper will be replaced as the primary document dissemination and storage medium by:<br>(a) Microforms<br>(b) Full text digital media<br>(c) Sound recordings<br>(d) Other (specify) |
| Question: | How can DDC get user feedback without reinitiating user surveys every year? |
| Event: | Automatic retrieval systems will have built in monitoring features, thus providing instant analysis of system use and user needs. |
| Question: | Will paper cease to be the primary document storage and dissemination medium for numeric data? |
| Event: | Paper will be replaced as the primary numeric data storage and dissemination medium by:<br>(a) Microforms<br>(b) Digital media<br>(c) Sound Recordings<br>(d) Other (specify) |

| | |
|---|---|
| Question: | Should DDC continue to support machine-aided indexing activities? |
| Event: | For scientific and technical report literature, the generation of acceptable index data from machine readable text will virtually eliminate the need for manual indexing. |
| Question: | Can DDC eliminate duplicate input keyboarding? |
| Event: | Optical character recognition devices will readily convert any document to machine-readable form, regardless of format or type font. |
| Event: | Increased use of word processing equipment will make machine readable versions of full text documents readily available. |
| Question: | Can DDC minimize original software development? |
| Event: | Use of commercially available software packages for document storage and retrieval applications will virtually replace original software development. |
| Question: | Can DDC approach a reasonable degree of computer manufacturer independence? |
| Event: | All packaged software will be machine independent. |
| Question: | Can the Defense on-line Retrieval System provide full conversational capability? |
| Event: | Conversational and tutorial on-line retrieval systems will evolve to the point where human intermediaries between the system and the requester become unnecessary. |

II. ORGANIZATIONAL STRUCTURES AND AFFILIATIONS

| | |
|---|---|
| Question: | Can DDC minimize overlap and duplication between its data base and others? |
| Event: | Duplication among major bibliographic data bases will be virtually eliminated through interorganizational agreements. |
| Question: | Is the distributed input processing concept preferrable to central input and processing at DDC? |
| Event: | Input of information to large IS&R systems (e.g., DDC, NTIS, NASA, etc.) will be decentralized, with abstracting, indexing, and data conversion provided at the local source level. |

| | |
|---|---|
| Question: | Will it be possible to merge DDC and other relevant data bases? |
| Event: | It will be possible for a user organization to readily merge available scientific and technical bibliographic data bases into a single file. |
| Question: | Should DDC adopt a more centralized approach? |
| Event: | Through ready access to a central information storage and dissemination facilities, users can bypass local information or library facilities and these can be eliminated. |
| Question: | What should be the relationship between DDC and its peers? |
| Event: | Machine-readable R&D data bases will be electronically linked so that a user of any one of these data bases can, with proper authorization, directly access any other data base through an on-line terminal. |
| Question: | Is a universally-adopted indexing vocabulary feasible? |
| Event: | A single standard, interdisciplinary subject indexing vocabulary adopted for use by all the major science information services. |
| Question: | Is a common, standardized citation format feasible for all technical literature, thus allowing free exchange of document surrogates among information-handling agencies? |
| Event: | Common, standardized citation formats for all technical report literature will be adopted by all scientific and technical information services. |
| Question: | Is a common, standardized abstract format feasible for all technical literature thus allowing free exchange of document surrogates among information handling agencies? |
| Event: | Common, standardized abstract formats for all technical report literature will be adopted by all scientific and technical information services. |
| Question: | Will DDC have to adopt a standardized protocol for DROLS? |
| Event: | Standardized user protocols for on-line interactive retrieval systems will be adopted by all technical information services. |

Question: Will Federal STINFO services be consolidated under one or more umbrella organizations, causing DDC to be merged with others?

Event: Virtually all Federal technical information services will be merged into a central organization.

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Question: What is the trade-off between DDC performing information processing with government personnel and delegating these activities to contractor staff?

Event: Federal agencies will employ contractor staff to perform virtually all of their information processing activities.

III. ECONOMICS AND MARKETING

Question: At what cost will DDC be able to supply each potential user with an economical interactive terminal?

Event: Each R&D professional will be able to purchase an interactive computer terminal for less than $500.

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Question: To what extent will DDC need to become self supporting?

Event: Federal technical information processing and dissemination activities will become virtually self-supporting.

IV. SCOPE OF SERVICES

Question: Can DDC and/or its users electronically tap into other relevant data bases?

Event: Using a single terminal, each R&D professional will be able to query any bibliographic or numeric data base of his choice.

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Question: Should DDC continue to publish its abstract journal (TAB) in paper form?

Event: In an R&D environment, interactive on-line access to bibliographic data bases will virtually (i.e., 90%+) replace the traditional abstracting and indexing journal in paper form as literature searching tools.

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Question: Will cheap and rapid document dissemination techniques preclude the need for dissemination of abstracts?

Event: Low cost, rapid dissemination of full text of documents will preclude the need for abstracts as document announcement and retrieval devices.

| | |
|---|---|
| Question: | Should DDC direct its efforts toward subscription and away from demand services? |
| Event: | Automatic delivery (as opposed to delivery upon demand) of information products such as documents and citations will become the rule; request services will become the exception. |
| Question: | How far should DDC go in providing tailored services to its users? |
| Event: | All major R&D information systems will permit the user to specify his own output format, with virtually no limitations on data order or structure. |
| Question: | Should DDC be wholesaling services to local libraries retailing services to individual users, or both? |
| Event: | Two tiers of information providers will emerge and be clearly definable: those large information services which wholesale their products to local libraries and service centers; and local activities which "retail" their products directly to end users. |
| Question: | Is the IAC concept viable? |
| Event: | All R&D personnel will have the option of requesting detailed analysis and synthesis of the literature of their discipline through an established service, such as an information analysis center. |
| Question: | Will numeric data collection, storage and retrieval become a major DDC service? |
| Event: | In the R&D environment, the collection, storage, and retrieval of numeric data will at least equal, if not surpass, in volume and importance, the processing of bibliographic information. |
| Question: | Should DDC provide highly select data bases of verified and reproducible research results? |
| Event: | R&D scientists will have access to discipline oriented data bases of highly select, certified and validated numerical data as opposed to bibliographic references to reported results and data bases of unverified data. |

# APPENDIX E. EVENTS CLASSIFIED BY DESIRABILITY/FEASIBILITY

## TABLE E-1. MOST DESIRABLE AND MOST FEASIBLE EVENTS

EVENT

A. TECHNOLOGY

- Most technical information retrieval will be accomplished by dial-up communications lines
- Facsimile transmission will be competitive with postal service in cost
- Paper will be replaced as primary numeric storage medium by digital media
- OCR will be able to convert any document to machine-readable form
- Word processing equipment making available machine-readable full text

B. ORGANIZATIONAL AFFILIATIONS

- Standardized citation formats
- Standardized abstract formats

C. ECONOMICS

- Facsimile transmissior competitive with postal service in cost

D. SERVICES

- Many data bases accessible through a single terminal

## TABLE E-2. MOST DESIRABLE AND MODERATELY FEASIBLE EVENTS

EVENT

A. TECHNOLOGY

- Machine readable storage media competitive with paper
- Files electronically transferred between different locations at low cost
- Commercial software packages replacing most original software development
- Most packaged software machine independent

B. ORGANIZATIONAL STRUCTURES AND AFFILITATIONS

- Standardized user protocols for on-line retrieval systems

C. SERVICES

- Major IS&R systems allowing choice of output
- Researchers have access to data bases of "factual" verified numeric data

## TABLE E-3. MOST FEASIBLE AND MODERATELY DESIRABLE EVENTS

EVENT

A. TECHNOLOGY

- Machine-readable storage competitive with microform
- Peripherals with mini's will take over many automated functions
- Interactive computer terminals available for less than $500
- High quality, low cost microfilm reader-printer available
- Paper replaced as document storage medium by microforms
- Automatic monitoring built into retrieval systems
- Paper replaced as numeric dissemination medium by full-text digital media

B. ORGANIZATIONAL AFFILIATIONS

- Two levels of information providers: "wholesalers" and "retailers"

C. ECONOMICS

- Interactive computer terminals available for less than $500
- High quality, low cost microfilm reader-printer available

D. SERVICES

- Interactive access to citation data bases replacing abstracting and indexing tools

## TABLE E-4. MOST FEASIBLE AND LEAST DESIRABLE EVENTS

EVENT

A. TECHNOLOGY

- Paper virtually replaced as a dissemination medium by microform

## TABLE E-5. MODERATELY DESIRABLE, MODERATELY FEASIBLE EVENTS

EVENT

A. TECHNOLOGY

- Associative memories commonly used for machine-aided fact retrieval
- "Personal" interactive terminals very common
- Paper replaced as document storage medium by full text digital media
- Acceptable machine-generated index data
- Tutorial features of on-line systems making intermediaries unnecessary

B. ORGANIZATIONAL AFFILIATIONS

- Unnecessary data base duplication eliminated

C. SERVICES

- "Personal" interactive terminals very common
- Tutorial features of on-line systems making intermediaries unnecessary
- Interactive access to full text data bases replacing abstracting and indexing as searching tools

## TABLE E-6. MODERATELY DESIRABLE AND LEAST FEASIBLE EVENTS

| | EVENT |
|---|---|
| A. | TECHNOLOGY |
| | • Associative memories will be commonly used in machine-aided retrieval |
| B. | ORGANIZATIONAL AFFILIATIONS |
| | • Standardization allowing user organizations to merge data bases onto a single file |
| C. | SERVICES |
| | • Information synthesis and analysis available to all researchers |

## TABLE E-7. MODERATELY FEASIBLE AND LEAST DESIRABLE EVENTS

| | EVENT |
|---|---|
| A. | TECHNOLOGY |
| | • Paper replaced as document dissemination medium by full-text microform media |
| | • Paper replaced as numeric storage medium by microforms |
| B. | ORGANIZATIONAL AFFILIATIONS |
| | • Decentralized input processing for large IS&R systems |
| C. | SERVICES |
| | • Processing of numeric data at least equalling the processing of bibliographic information |

## TABLE E-8. LEAST DESIRABLE AND LEAST FEASIBLE EVENTS

| | EVENT |
|---|---|
| A. | TECHNOLOGY |
| | • Computers designed specifically for bibliographic storage and retrieval |
| | • Paper replaced as document dissemination medium by full-text digital media |
| B. | ORGANIZATIONAL AFFILIATIONS |
| | • One interdisciplinary subject vocabulary |
| C. | ECONOMICS |
| | • Federal technical information services self-supporting |
| D. | SERVICES |
| | • Dissemination of full text of documents precluding need for abstracts as announcement devices |
| | • Dissemination of full text of documents precluding need for abstracts as retrieval devices |